TWO SILVER MEDALS, PARIS, 1878.
THE CHILIAN MEDAL, SANTIAGO, 1875.

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**Partnerships. — Gentlemen** (Practical Engineers) desirous of entering established Engineering concerns, are invited to communicate with the undersigned, who have numerous bona fide establishments open to admit such. References are given and required.—WHEATLEY KIRK, PRICE AND GOULTY, Albert Square, Manchester.

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**Engineering Firms of Good** REPUTE, open to admit partners, or desirous of selling outright, are requested to communicate with the undersigned, who have numerous clients open for such.—WHEATLEY KIRK, PRICE AND GOULTY, Albert Square, Manchester.

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COUNTY OF DURHAM.
Valuable Colliery for Sale.

**To be Sold by Auction, by** Order of the Liquidators of the Rosedale and Ferryhill Iron Company (Limited), at the Board Room, Royal Exchange, Middlesborough, on TUESDAY, the 3rd of February, 1880, at half-past Twelve for One o'clock precisely (unless previously disposed of by Private Contract, of which notice will be given), Mr. CHARLES WILLMAN, Auctioneer, the well-known THRISLINGTON COLLIERY, situate near Ferryhill, in the county of Durham, and producing some of the finest hard Coal in the County, known on the London Market as the "South Kelloe Coal;" partly held under Lease, for a term of 63 years, from the 1st of October, 1865, at the certain annual rent of £750, and tonnage rents in addition, and partly held under Lease, for a term of years expiring on the 6th of October, 1884, at the certain annual rent of £1500, and tonnage rents in addition; together with all the necessary Colliery Engines, Gear, and Plant, in full operation; and also upwards of 100 coke ovens, in good repair; also the Farm known as THRISLINGTON FARM, situate in the parish of Bishop Middleham, in the county of Durham, and containing 300a. 2r. 10p., in the occupation of Mr. William Parker as sub-tenant; and held under Lease, for a term of 21 years, from the 12th of May, 1865, at an annual rent of £340, and also the several Lands, Buildings, and Cottages, belonging to the Rosedale and Ferryhill Iron Company (Limited), situate near and held and occupied with the above Colliery. The premises may be viewed on application to W. H. Wood, Esq., Mining Engineer, West Hetton Lodge, Coxhoe. Particulars, with Plans and Conditions of Sale, are in course of preparation, and may shortly be obtained from W. H. Wood, Esq., John Marley, Esq., M.E., Darlington; Edward Williams, Esq., Middlesborough; the Liquidators of the Rosedale and Ferryhill Iron Company (Limited), Middlesborough; and from DODDS and Co., Solicitors, Stockton-on-Tees.

Stockton, 1st January, 1880.

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TELEGRAPH PLANT, MATERIALS, TOOLS, &c.

**Mr. J. C. Stevens has** received instructions from the British Telegraph Manufactory (Limited) to SELL BY AUCTION, on the Company's premises, No. 374, Euston Road, N.W., on WEDNESDAY, February 4th, at half-past 12 precisely, a THIRD PORTION OF THE STOCK, PLANT, MATERIALS, TOOLS, FURNITURE, FIXTURES, &c., belonging to the Company, including Telegraph Instruments, Wheatstone A, B, C, Roman Type-Printer and Magneto-Electric Exploders, large Gramme Light and Plating Machines, Office Furniture, Benches, Cupboards, Stocks of Drawers, Raw Materials, and numerous Tools. May be viewed between 11 and 4 o'clock the day prior and morning of sale, and catalogues had on the premises, and of Mr. J. C. STEVENS, Auctioneer and Valuer, 38, King Street, Covent Garden.

---

**London Agency.—A Firm** representing Large Works in Wales are open to act as AGENTS for WORKS making Steel or Finished Iron. They have a good connection amongst Engineers, Merchant-Shippers, &c. Address—C. X., care of Messrs. G. Street and Co., 30, Cornhill, E.C.

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**Valuable Freehold Estate** in Gloucestershire, containing HEMATITE IRON ORE and COAL, proved on North and South Boundaries, extent 200 acres, to be Sold or Let on Royalty. Situate close to Midland Railway. The ore contains 60 per cent of iron.—Apply for full particulars to E. R. SALWEY, C.E., Bridgend, South Wales.

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TO IRON SHIPBUILDERS, ENGINEERS, AND OTHERS.

**To be Let, valuable and** extensive PREMISES, Shops, &c., adjoining the entrance to the South Dock, Swansea, and in about the centre of the Dock Estate.

Three years' lease at a moderate rental.
Apply to the General Superintendent.
Harbour Offices, Swansea,
8th January, 1880.

N.B.—The late tenants having dissolved partnership, a business as above was put an end to.

---

WEAR IRONWORKS.

**For Sale (by Private** Treaty) the valuable and modern Puddling Forges, Plate Mills, Angle Mills, and Bar Mills, known as the WEAR IRONWORKS, situate at Castletown, near Sunderland, on the north bank of the river Wear, and in close proximity to the shipbuilding yards and manufacturing works on the river.

The works stand on 25 acres of freehold land, have a good private wharf, and are most advantageously connected by railway with the sources of fuel supply and the inland markets for finished iron.

The Plant and Tools are very efficient, and the works could be put into operation with a small outlay of time and money, and are capable of turning out 800 to 1000 tons of shipbuilding iron, boiler plates and merchant bars per week, with space for large increase.

Adjoining there are 10½ acres of additional freehold land, on part of which 174 workmen's houses have been built, leaving nearly half of the land vacant and available for building purposes.

Further particulars and permission to inspect the property may be obtained on application to Messrs. A., B. and C. Wright, Solicitors, Sunderland.

---

THE MONGES IRON MINE, PORTUGAL.

**The Proprietors of this** well-known Valuable Property having appointed the undersigned sole agents for the SALE of the MINE AND PLANT, they will be glad to afford Ironmasters and Projectors of Public Companies all information.

HANNAN, WATSON AND CO.,
Glasgow.

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LIMESTONE QUARRY ON SALE.

**On Sale (by private treaty)** A FIRST-CLASS LIMESTONE QUARRY, together with fixed and moveable PLANT, Locomotive, Steam Crane, Stone Crusher, Engine and Boiler, &c., situate at Wirksworth, in the County of Derby, on the Midland Railway (and connected therewith by its own sidings).

The site comprises over 10 Acres of Splendid Limestone, together with Kilns, Offices, Cottages, and every appliance for doing a very extensive trade. The stone is of the best quality, and in good demand.

For further particulars and to treat apply to
Mr. T. H. HARRISON,
Public Accountant.
18, Wardwick, Derby.

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**The Pacific Steam Naviga-**TION COMPANY invite offers for the purchase of a

40-cwt. RIGBY'S PATENT STEAM HAMMER,
10-ton CRANE, and a
GORMAN PATENT FURNACE.

Length of Hammer stroke about 4 feet, Cylinder 22 inches in diameter.

The above articles were made in 1874 by Glen and Ross, Glasgow, but have never been erected.

Further Particulars, if required, can be obtained from the undersigned.

Offers should be addressed to the Directors and marked "Offers for Steam Hammer, &c.," and should be delivered not later than 31st inst.

The Directors do not bind themselves to accept the highest or any offer.

A. M. SAUNDERSON,
Manager and Secretary.
Company's Offices,
31, James Street, Liverpool,
January 15th, 1880.

---

IN LIQUIDATION.

**To be Sold by Private** TREATY, as a going concern, on the Great Northern Line of Railway, a well-established ENGINEERING BUSINESS, comprising the following branches, viz.:—

THE MANUFACTURE OF STATIONARY ENGINES AND BOILERS.
PORTABLE AND COMBINED ENGINES AND BOILERS.
AGRICULTURAL IMPLEMENTS OF ALL CLASSES.

And especially the manufacture of Wrought-Iron Cranks, for which a complete plant of Patent Machinery has been put down; also General Iron Founding, with all the appliances for carrying on and extending a first-class trade.

The Machinery and Tools are by well-known makers, and the new buildings are erected upon lands secured on a 990 years' lease.

Full particulars can be obtained from Mr. Isaac Jenks, of Wolverhampton; Mr. Thomas Leman, Accountant, Nottingham; or Messrs. Corser, Fowler, and Langley, Solicitors, Wolverhampton.

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IRON BUOY SINKERS.

**This Corporation being** desirous of receiving Tenders for the Supply of IRON BUOY SINKERS, notice is hereby given that Specifications and Forms of Tender may be had on application at the Store Department at this House, on any day between the hours of 10 a.m. and 4 p.m. Tenders, sealed and marked outside "Tender for Iron Buoy Sinkers," must be addressed to the Secretary, and delivered at this House on MONDAY, the 9th February, and no Tender can be entertained that is not made on the form provided.

The Corporation does not pledge itself to accept the lowest or any Tender.

By Order.
ROBIN ALLEN,
Secretary.
Trinity House, London,
27th January, 1880.

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TO BE SOLD.

Pursuant to an order of the High Court of Justice Chancery Division, made in the matter of the Companies Acts, 1862 and 1867, and in the matter of THE NORTON IRON COMPANY LIMITED, with the approbation of His Lordship the Master of the Rolls, in two lots, by

**Mr. Charles Willman C.E.,** M.E., the person appointed by the said Judge, at the Board Room, Royal Exchange, Middlesborough, on TUESDAY, the 10th Feb., 1880, at 12.30 p.m. precisely, the properties consisting of FREEHOLD BLAST FURNACES, RAILWAY CHAIR FOUNDRY, and other properties known as the Norton Ironworks, also TWO CORN MILLS, known as the "Norton" and "Billingham" Mills, and more particularly described as follows:—

LOT 1.

Three closes of FREEHOLD LAND, situate in the township and parish of Norton, in the county of Durham, and containing by admeasurement 23 ACRES or thereabouts, with the SIX BLAST FURNACES, RAILWAY CHAIR FOUNDRY, GAS WORKS, FITTING AND REPAIRING SHOPS, and other buildings thereon, known as the Norton Ironworks, together with the Steam Engines, Boilers, Steam Pipes, Shafting and Gearing, and Fixed Machinery, and the Workshops, Show Rooms, Timber Yard, and Implement Yard. Packing and other Sheds, Gas Retorts, Holders, and Pipes, and Weighing Machine and Weigh Engine now erected and standing thereon.

Also three pieces of FREEHOLD LAND adjoining the above, situate in the township of Wolviston, in the parish of Billingham, in the county of Durham, and containing together 19 acres or thereabouts, available for tipping slag.

The purchaser will be required to take the loose plant, loose tools, and loose stock in and about the Norton Ironworks and premises (Lot 1), a schedule whereof will be produced at the Auction, at a valuation to be made as specified in the conditions of sale. The purchaser of Lot 1 will have the option, to be declared on the fall of the hammer, of purchasing Lot 2 at a price which will be stated by the Auctioneer. Should such option be declined, the sale of Lot 2 will proceed in the usual manner.

NOTE.—The before-mentioned Lot 1 will be put up or offered for sale at an upset price of £45,000, which has been fixed by the Judge to whose Court the winding-up of the said Company is attached.

LOT 2.

All that FREEHOLD WATER CORN MILL, called "Norton Mill," situate in the township and parish of Norton aforesaid, and the lands held therewith, and the lane leading from the said Mill to Norton, containing together 13 acres, 1 rood, 6 perches, or thereabouts, and also all that close of LEASEHOLD LAND, situate in the township of Billingham, containing 7 acres, 3 roods, 5 perches, held for the residue of a term of twenty-one years, from the 1st December, 1867, created therein by lease from the Dean and Chapter of Durham, dated the 15th February, 1878, subject to the yearly rental of 1s., and to the covenants and reservations in such lease contained.

Also all that LEASEHOLD WATER CORN MILL, called "Billingham Mill," situate in or near to the township of Billingham aforesaid, and those TWO CLOSES adjoining thereto, containing together 11 acres, 0 roods, 20 perches, or thereabouts, and held for the residue of a term of twenty-one years from the 14th day of September, 1866, created therein by lease from the Dean and Chapter of Durham, dated 21st September, 1866, subject to the yearly rent of £6 13s. 4d., and to the covenants and reservations on such lease contained.

Particulars and Conditions of Sale and any further information may be obtained on applying to the Auctioneer, Exchange-place, Middlesborough; or to the Official Liquidator, Mr. A. E. Wenham, 50, Ann-street, Birmingham; Messrs. Sharpe, Parkers and Co., 41, Bedford-row, London, W.C., Solicitors; Messrs. Slater and Turnbull, 22, Cooper-street, Manchester, Solicitors; or to Messrs. RYLAND, MARTINEAU, CARSLAKE and GOODWIN, 7, Cannon-street, Birmingham, Solicitors.

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**To Ironfounders. — The** UNDERSIGNED have invented a simple and efficient method to manufacture POROUSLESS CAST IRON for small hardware, and will give instructions and full particulars on receipt of £15. The arrangement is costless, funnel and drying moulds are not necessary, and no alteration is to be made in the foundry. Advertisers produce daily by this method in their own foundry 100 cwt. of cast iron, amongst which are plates of 1 cwt., cast horizontally.—SEBOLD and NEFF, Engineers and Founders, Durlach, Baden. London references, Messrs. NATHANIEL COHEN and Co., Bankers.

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**Advertiser desires to meet** with a FIRM to take up the Agency and Manufacture of VALUABLE PATENTED MACHINERY and APPARATUS relating to one of the foremost questions of the day, who would be willing to advance some capital towards defraying part of the expenses incurred thus far in developing and perfecting the invention. The Patent is now working successfully in several places, and advertiser is already in negotiation for further contracts to the amount of between £40,000 and £50,000. Address—"ENGINEER," care of Messrs. Tangue and Birkbeck, Patent Agents, 34, Southampton Buildings, London, W.C.

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**"How to Make Money by** PATENTS." Free, by post, 14 stamps.—BARLOW and YOUNG, Patent Agents and Consulting Engineers, 23, Southampton Buildings, W.C.

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BY ORDER OF THE SECRETARY OF STATE FOR INDIA IN COUNCIL.

INDIAN STATE RAILWAYS.

**The Director-General of** Stores for India is prepared to receive Tenders from such persons as may be willing to supply METALLIC FITTINGS for RAILWAY CARRIAGES.

The Conditions of Contract may be obtained, and the Drawings inspected, on application to the Director-General of Stores, India Office, Westminster, S.W., and Tenders are to be left at his office at any time before Two o'clock p.m., on TUESDAY, the 17th February, 1880, after which no Tender will be received.

A. ABERCROMBIE JOPP,
Director-General of Stores.
India Office, 30th January, 1880.

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BY ORDER OF THE SECRETARY OF STATE FOR INDIA IN COUNCIL.

INDIAN STATE RAILWAYS.

**The Director-General of** Stores for India is prepared to receive Tenders from such persons as may be willing to supply 50 LOCOMOTIVE ENGINES and TENDERS, 5 feet 6 inches gauge.

The Conditions of Contract may be obtained and the Drawings inspected on application to the Director-General of Stores, India Office, Westminster, S.W., and Tenders are to be left at his office at any time before Two o'clock p.m., on TUESDAY, the 10th February, 1880, after which no Tenders will be received.

A. ABERCROMBIE JOPP,
Director-General of Stores.
India Office, 30th January, 1880.

---

BY ORDER OF THE SECRETARY OF STATE FOR INDIA IN COUNCIL.

INDIAN STATE RAILWAYS

**The Director - General of** Stores for India is prepared to receive Tenders from such persons as may be willing to supply IRONWORK FOR BRIDGES of 40 feet spans—5 feet 6 inches gauge.

The Conditions of Contract may be obtained and the Drawings inspected on Application to the Director General of Stores, India Office, Westminster, S.W., and Tenders are to be left at his office at any time before Two o'clock p.m. on TUESDAY, the 10th February, 1880, after which no tender will be received.

A. ABERCROMBIE JOPP,
Director-General of Stores.
India Office, 30th January, 1880.

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Great Dover Street.—By order of Mortgagees.—Capital Corner Premises, with dwelling-house and stabling, situate close to St. George's Church, suitable for Railway and other Carriers, Ale Stores, Contractors, Engineers, or any business where an extensive Ground Floor Area is essential. With possession.

**Messrs. Debenham, Tew-**SON and FARMER will SELL, at the Mart, on TUESDAY, March 9, at 2, the BENEFICIAL LEASE of the capital block of FACTORY PREMISES, Nos. 55a, 56, and 57, Great Dover Street, Borough, possessing a frontage of 120 feet by a depth of 300 feet, and comprising a spacious building of four floors (including basement), a large timber building in rear, an open yard with gateway, and counting-house over; also a 10-roomed dwelling-house, a modern, brick-built factory (all ground floor), and a considerable covered space in rear of yard. There is also a cartway entrance from Bland Street, and stabling. Held for a term expiring at Midsummer, 1895, at a nominal rent. Particulars of H. R. G. Fowkes, Esq., Solicitor, 15, Walbrook; and of the Auctioneers, 80, Cheapside.

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**Iron Merchant. — Wanted** a Gentleman of energy and perseverance, with experience in the Iron Trade, to open and conduct a London Branch for a Middlesborough House, having as yet no connection in London. Written applications addressed to Y., *Iron and Coal Trades Review Office*, Middlesborough.

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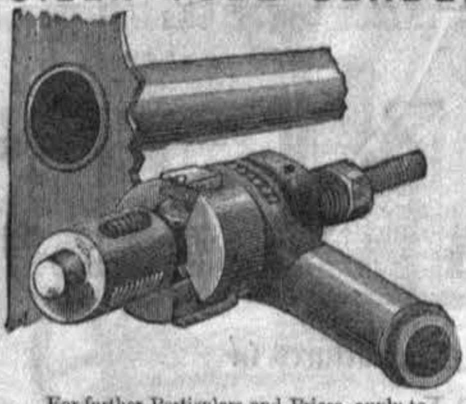

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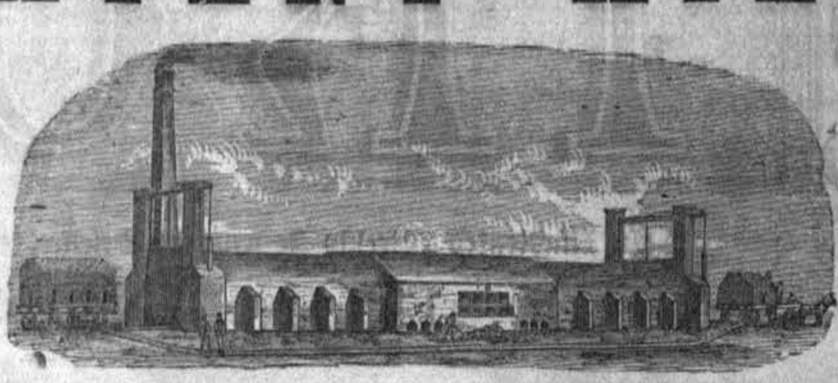

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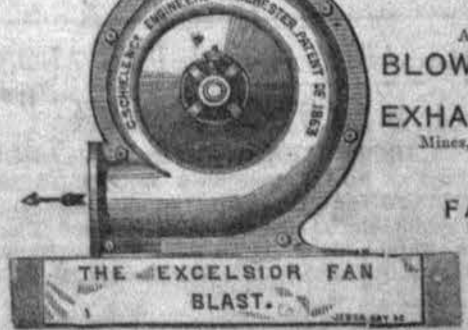
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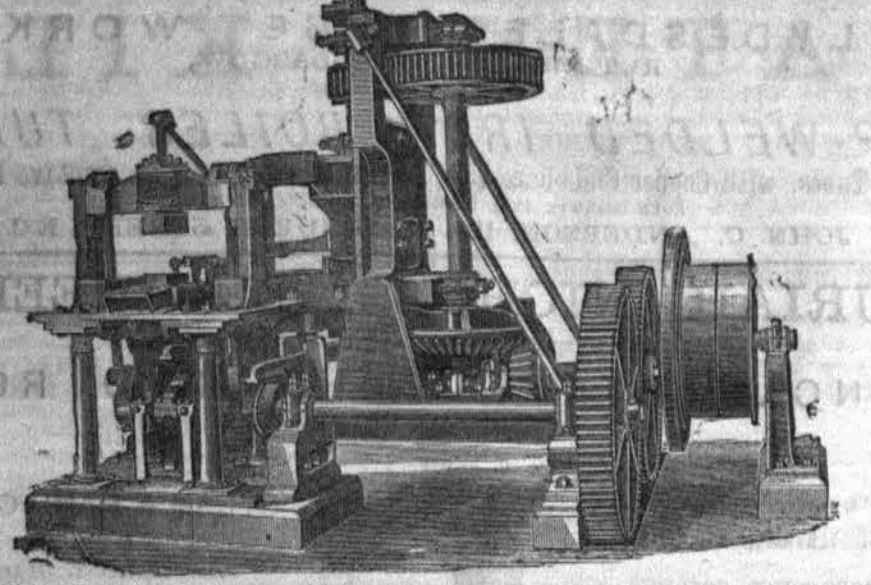

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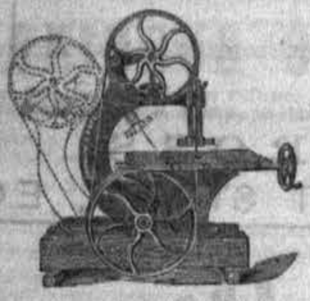

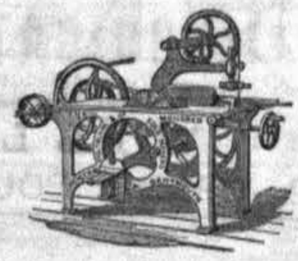

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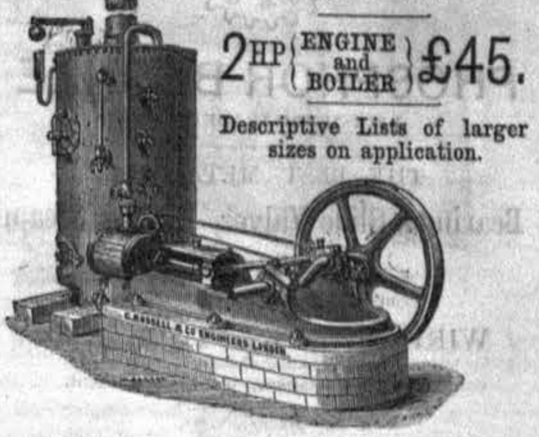
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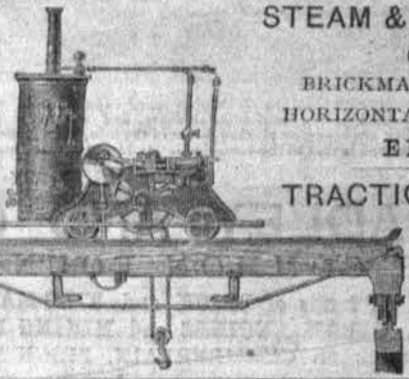

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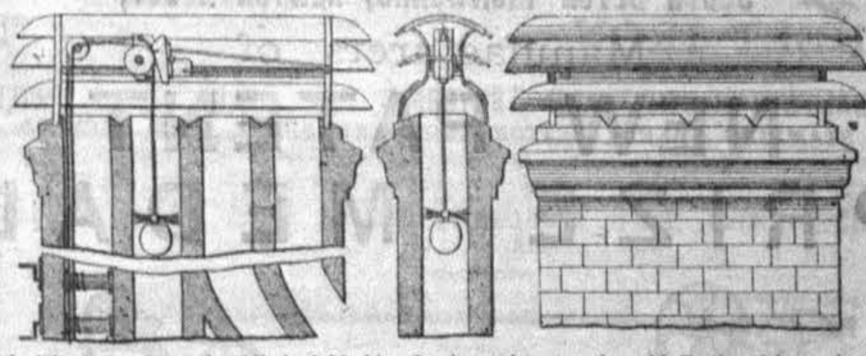

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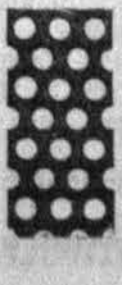

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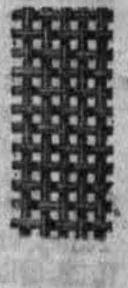

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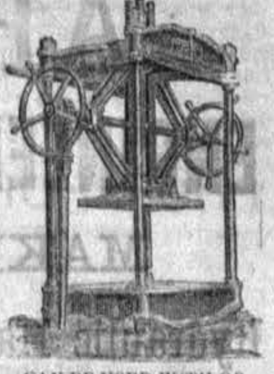

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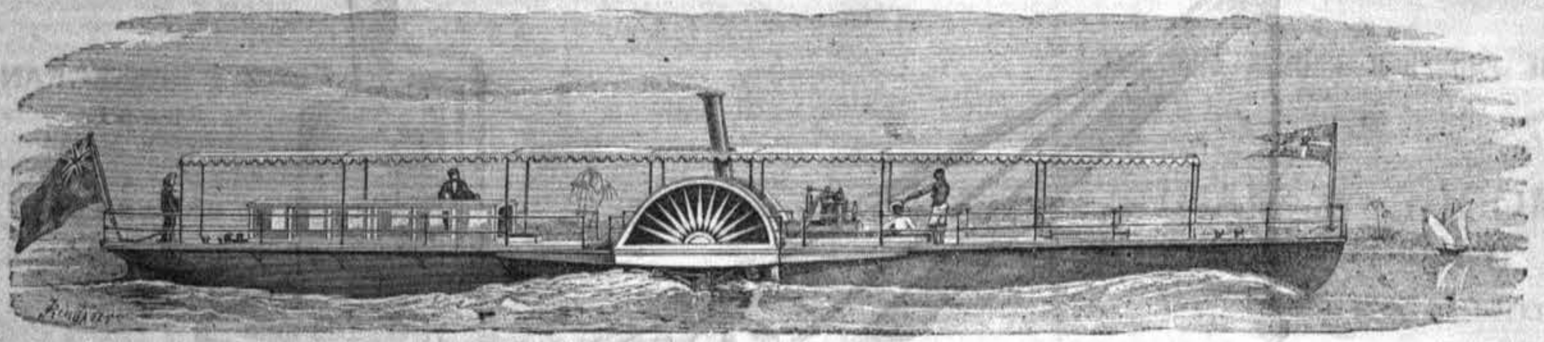

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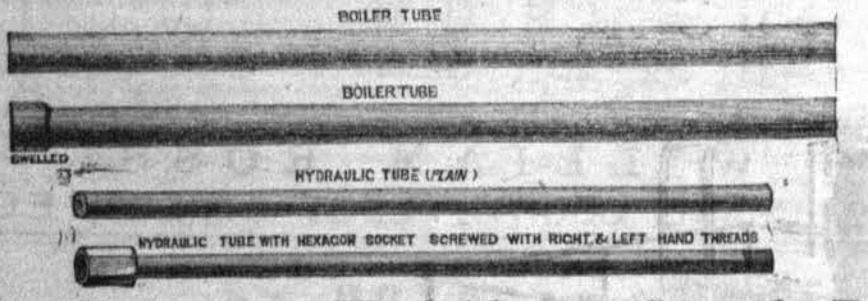
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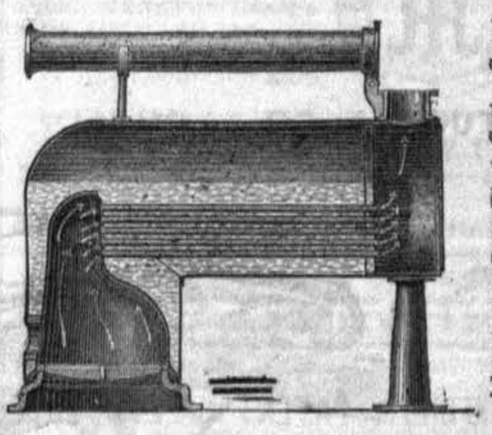

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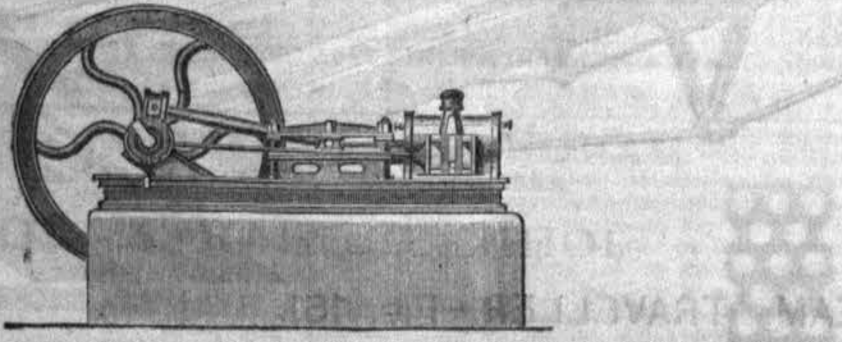

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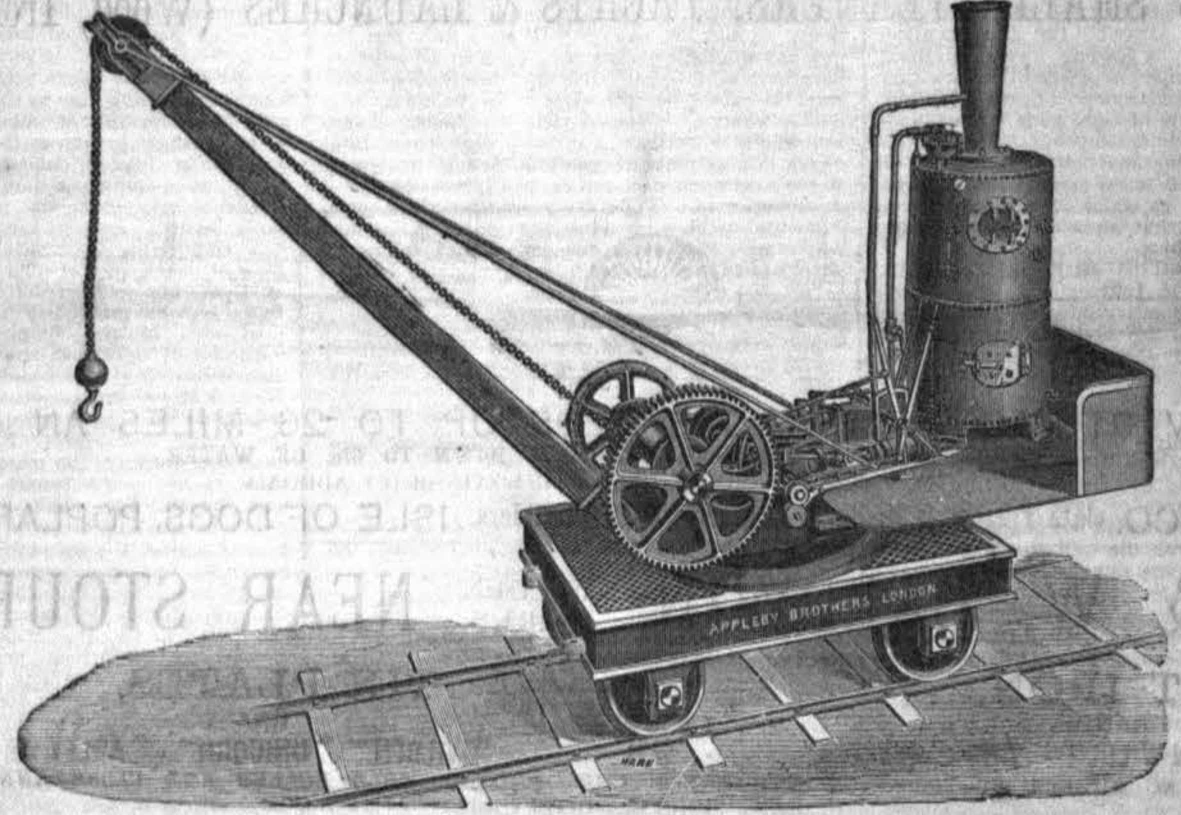
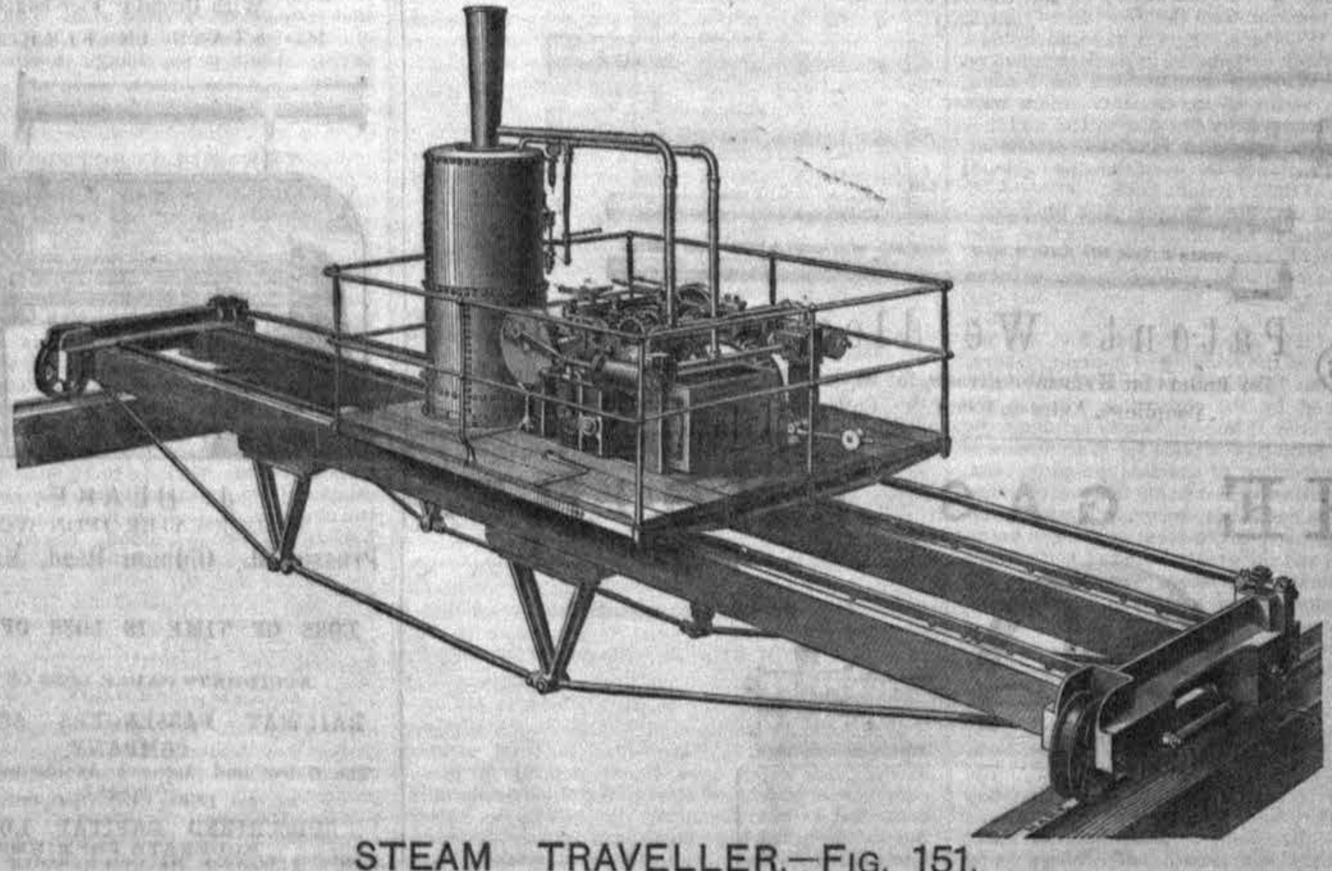


FIVE TONS STEAM CRANE.—Fig. 116.



STEAM TRAVELLER.—Fig. 151.

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IRON.

LONDON, FRIDAY, FEBRUARY 6, 1880.

## THE THUNDERER'S 38-TON GUN.

THE crucial test of doubly-loading has been applied to the *Thunderer's* second 38-ton gun with the result that that weapon now lies in fragments on the proof-range at the Royal Arsenal, Woolwich. Up to the last moment of the final round being fired, opinions were divided—although not equally—as to what would be the issue. The committee were unanimous in the maintenance of their opinion that the gun would not survive what they and others considered to be a sacrificial ordeal, and the results have gone to establish the deliberate conclusion at which they arrived. The gun has given way under conditions of loading similar to those under which the committee concluded the sister gun burst with such fatal consequences thirteen months ago, and the fragments of both guns present lines of fracture very closely analogous. The circumstances which led to the final test being applied to the gun must be so fresh in the minds of our readers, and the experiments by which it was preceded so well in remembrance, that we need now do no more than briefly refer to them.

It will be remembered that after the *Thunderer's* gun burst on the 2nd of January last year various opinions, more or less authoritative in their nature, were expressed as to the probable cause of the accident. Doubts were thrown on the safety of this class of guns even under ordinary conditions of working. The result was the appointment of a special committee to enquire into the whole circumstances of the accident. The conclusion at which the committee arrived was that a previous charge of 110 lb. of powder and a Palliser shell had not been fired, and that a charge of 85 lb. of powder and a common shell had been loaded in front of it, and that both had exploded with the well-known and fatal results. This opinion was rejected by many who advanced theories of their own, and supported them both by argument and—as in Sir William Palliser's case—by successful experiment also. Of the various rival hypotheses advanced, some went to show that the gun had burst with an ordinary charge, owing to the defective nature of the materials of which it was made, the weapon having been unduly strained by previous rounds. Others were founded upon the notion that an air-space had been left between the powder-charge and the base of the projectile. Lastly, we had the theory of jamming propounded, which was strongly supported by Sir William Palliser. All these views served to create a vague distrust in the 38-ton guns in service, and in order to remove this it was resolved to test each theory in the sister gun which was removed from the *Thunderer's* turret and brought to Woolwich, where it has undergone a series of trials which culminated in its destruction on Tuesday last. We have summarised the leading features of the series of experiments which were carried out as arranged by the committee, and they will be found in the appended tabulated statement, which shows at a glance the conditions and general results of each of the 17 rounds fired.

It will be seen that the charges were fired alternately with common and Palliser projectiles, and that the first two charges were rammed close home. Rounds 3 to 14 were fired with air-spaces between the powder-charge and the base of the projectile ranging from 1 foot in the first, to 10 feet in the last round of this series. Rounds Nos. 15 and 16 were fired to test the wedging or jamming theory, whilst the last round illustrated that of doubly-loading, as advanced by the committee. Before the final round was fired it was necessary to obtain the sanction of the Secretary of State for War, in view of the possible destruction of national property, and, under the circumstances, such sanction was of course given. Provision had also to be made against accident to life or property in the event of the gun bursting, and to this end the great mound of earth which covered the bursting chamber was made doubly strong by masonry, timber and bags of sand, and the gallery in front, 50 feet long, was packed full of sand and fortified on every side. About 15,000 bags, each containing a yard of sand, were used to ensheath this enclosure, which was thus converted into a butt for the reception of the projectiles and the fragments of the gun, should it be destroyed. Heavy balks of timber were also employed to impart additional strength to the roof and further end. The narrow opening between the mouth of the bursting cell and the gallery was slightly enlarged to facilitate the escape of the powder-gases, but the outlet through the gallery was closed. All things being ready, the gun was loaded in the presence of a large concourse of officials, artillerists and representatives of various foreign Governments. The charge consisted firstly of 110 lb. of powder, a Palliser projectile of 700 lb. and a *papier maché* wad, and next of 85 lb. of powder, a common shell of 600 lb. and another wad. The position of the charge was marked on the outside of the gun, and indicated that the 85 lb.-charge lay just at that part of the weapon where the outer tube or coil terminates. The gun having been fired, there was a loud report, and an upheaval of earth and *débris*. The smoke having cleared off, the cell was entered and the fragments of the gun indicated the result.

The correctness of the conclusions of the committee have thus been substantiated, and the result of the experiment shows that the conditions which they assumed to exist at the time the *Thunderer's* gun was burst were at least sufficient to produce that effect. Confidence will no doubt be restored in guns constructed on the Woolwich system, under ordinary conditions of use. But if it is possible for abnormal conditions to arise in practice during peace, it is much more likely that they should happen in the heat of a naval engagement. Hence it will be necessary to inquire how far this class of gun is capable of meeting such contingencies, or how far it may be necessary to modify a system of construction which is only safe while the guns are fired under ordinary conditions. It may be, and no doubt is, a fact that the gun has an ample margin of strength for all ordinary purposes, but it is quite clear that it is inadequate to meet the strain brought upon it by the firing of a double charge. Granted that the double charge was wholly exceptional, and that it might never occur again, still we must assume that having, according to the committee, occurred once, it is possible for it to be repeated. Whilst the conditions which go to render a repetition possible exist, it is of paramount importance that every element of risk should be most carefully eliminated.

SUMMARY OF RESULTS.

| Round No. | Date of firing. | Charge of P.² powder in lbs. | Projectile. | Initial velocity in feet per second. | Chamber pressure in tons per square inch. | Disposition of charge. |
|---|---|---|---|---|---|---|
| | 1879. | | | | | |
| 1 | Dec. 9 | 85 | Empty common shell 587 lb. | 1440 | 20·2 | Charge rammed home. |
| 2 | ,, 10 | 110 | Palliser projectile, 703 lb. | 1408 | 21·8 | ,, |
| 3 | ,, 10 | 85 | Common, 587 lb. | 1272 | 12·4 | Air-space of 1 foot between powder and projectile. |
| 4 | ,, 10 | 110 | Palliser, 703 lb. | 1311 | 15·2 | ,, |
| 5 | ,, 15 | 85 | Common, 586 lb. | 1174 | 9·9 | ,, of 2 feet. |
| 6 | ,, 15 | 110 | Palliser, 680 lb. | 1223 | 12·7 | ,, |
| 7 | ,, 15 | 85 | Common, 586 lb. | 941 | 4·0 | ,, 4 feet. |
| 8 | ,, 15 | 110 | Palliser, 704 lb. | 1013 | 12·6 | ,, |
| 9 | ,, 15 | 85 | Common, 592 lb. | 780 | 2·2 | ,, 6 feet. |
| 10 | ,, 15 | 110 | Palliser, 876 lb. | 876 | 8·9 | ,, |
| 11 | ,, 16 | 85 | Common, 592 lb. | 664 | 1·5 | ,, 8 feet. |
| 12 | ,, 16 | 110 | Palliser, 701 lb. | 754 | 7·4 | ,, |
| 13 | ,, 16 | 110 | Palliser, 700 lb. | 582 | 6·1 | ,, 10 feet. |
| 14 | ,, 16 | 85 | Common, 600 lb. | 536 | 0·5 | ,, |
| | 1880. | | | | | |
| 15 | Jan. 16 | 85 | Common, 592 lb. | — | — | Papier maché wad, 5 feet, placed in front of projectile, and canted over to an angle of 45°. |
| 16 | ,, 16 | 85 | Common, 592 lb. | — | — | Wad placed at same point in bore, but vertically. |
| 17 | Feb. 3 | 110 | Palliser, 700 lb. | — | — | Both charges rammed well home in the gun. |
| | | 85 | Common, 600 lb. | — | — | |

## OUR TRADE SUMMARY.

THERE is again little change to report in the general aspect of the iron trade from last week. The demand for average and inferior qualities of pig has certainly slackened somewhat, and that portion of the trade which more directly depends for prosperity on a revival of other national industries still depressed is not advancing so rapidly as those interested could wish. There have been considerable fluctuations in the Glasgow warrant market, consequent, mainly, on the diminishing American demand, and prices closed on Wednesday at 66s. 3d. to 66s. 9d. a month, sellers 3d. per ton less. Although the manufactured iron works in the Glasgow district are fully employed and prices firm, yet new orders are coming but slowly in. The shipbuilding trade, on the other hand, while showing continued activity, is in receipt of several new contracts for large vessels, including, it is rumoured, a steel-plated ram for the Argentine Republic. There is a quiet but steady business doing by founders and engineers generally. At Middlesborough, on Tuesday, the market closed at a decline, in sympathy with the state of affairs in Glasgow. The Northern ironmasters' returns for January indicate great activity in the iron trade of the district, during the past month, embracing both an increased output and larger sales. New furnaces are being blown in, and activity also continues to characterise the finished trade, whilst engineering and ironfounding, with the minor branches of the iron industry, are beginning to feel the improvement of the times. In the North Lancashire district and West Cumberland, hematite iron continues very firm with plenty of orders forward, the business doing being in almost every case six or nine months in advance, makers having in many instances sold the output of their furnaces up to August or September. Prices for all descriptions are steadily maintained at the high quotations reported last week, and hematite ore, having become scarce, is very firm at from 30s. to 35s. per ton at the mines. The output is, however, steadily increasing day by day, owing to the energetic development of mining industry. There is no change to report from Manchester. Pig-iron is in limited demand, but there is still plenty of inquiry for forge, although, as the supply is very short, the transactions are necessarily limited. Foundry iron is little inquired for. The engineering departments are still slack, but there are some signs of activity in the machine shops. In Derbyshire and North Lincolnshire the production of pig-iron proceeds with increased energy. The production in the Barnsley district shows no indication of falling off, and there is considerable animation in the foundry and some other branches. There is also a very large output of Bessemer steel rails and other railway appliances. As regards the Leeds and West Yorkshire district, its chief iron industry, the manufacture of best Yorkshire, is not so satisfactory as had been expected and hoped for. The ironfounders anticipate a fall in existing rates of pig-iron, but they are buying against the orders in hand; nail-making is active, but there is no improvement to report in the engineering, tool and machinery trades. From the Sheffield district we have encouraging accounts. The state of the iron trade there indicates permanency of the present improvement in a greater degree than has been hoped for, American orders are coming in, and prices are not likely to decrease for a considerable period; while the rates of manufactured are assimilating more closely to those of the raw material. The staple trades of the town are likewise improving, the workmen being more generally employed, and getting higher wages. The firms which have introduced the new machinery are most actively engaged. The hardware industries of Birmingham have been receiving a moderate amount of business, but orders do not increase to the extent that manufacturers would wish. The kindred trades of South Staffordshire, however, appear to be doing better. There is no change to report in the coal trade.

## THE SUN ELECTRIC LIGHT.

ANOTHER candidate for favour as regards electric lighting has just been brought under public notice. This is the Sun Electric Light, of which an exhibition took place on Wednesday at the experimental factory, No. 80, Gray's Inn Road, London. This light is the invention of Mr. Harrison, and consists of a lamp in which the regulation or adjustment of the voltaic arc is effected automatically, and without the aid of wheels, springs, or any other similar mechanical devices. Owing to the circumstance that the foreign patents have not yet been completed, we are not in a position to place the details before our readers. In the course of a few weeks, however, we hope to be able to do so. All we can at present state is that the lamp consists of two carbon rods, ⅜ of an inch in diameter, fixed in holders attached to a stand. The carbons are placed one over the other in a vertical position, the top being the positive and the bottom the negative carbon. The carbons are manufactured by the Sun Electric Light Company, with a special view to the uniformity of their texture which is so necessary to the steadiness of the light. The lamp exhibited was the one designed for lighting railway stations, mines, collieries and workshops. It is not larger than the Serrin lamp, which it is designed to supersede. The current was produced from a Gramme continuous-current machine, and a good and steady light was produced. It was, however, subject to occasional variations of intensity, owing to the circumstance that the engine which drove the Gramme machine was also driving several other machines in the factory which were being used intermittently. Hence the occasional slight variations in the electric light. For street purposes a lamp has been designed in which the point of light is placed inside the bottom of the lamp standard, the rays being directed upwards (through the

# HUNGARIAN MILLING MACHINERY.

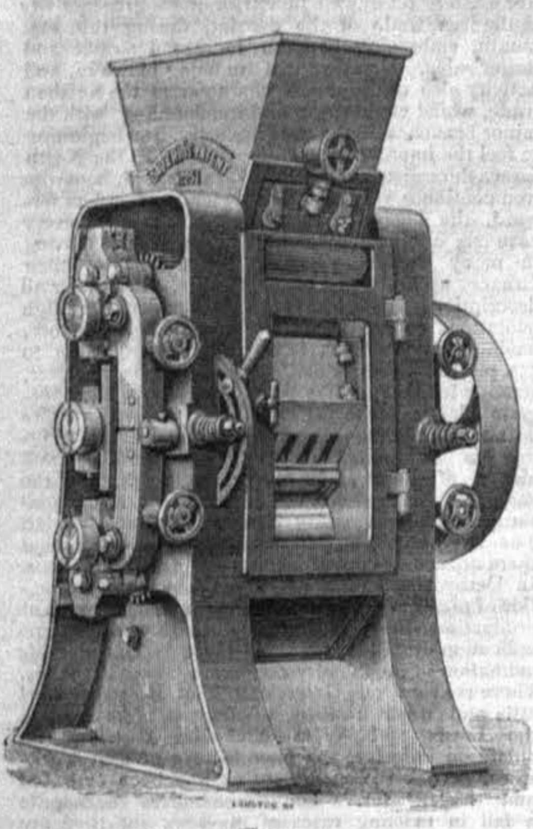

FIG. 1.

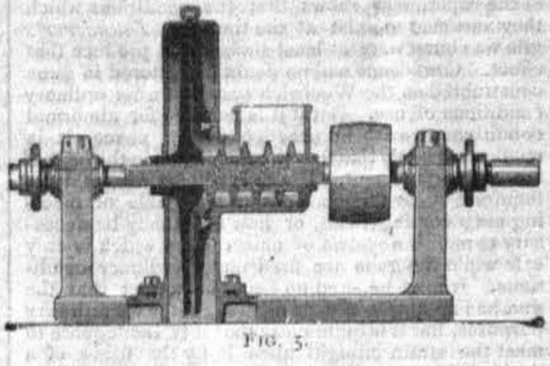

FIG. 5.

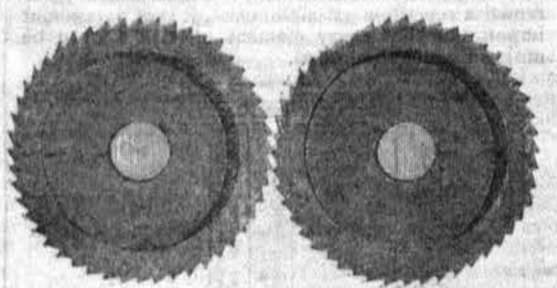

FIG. 3.

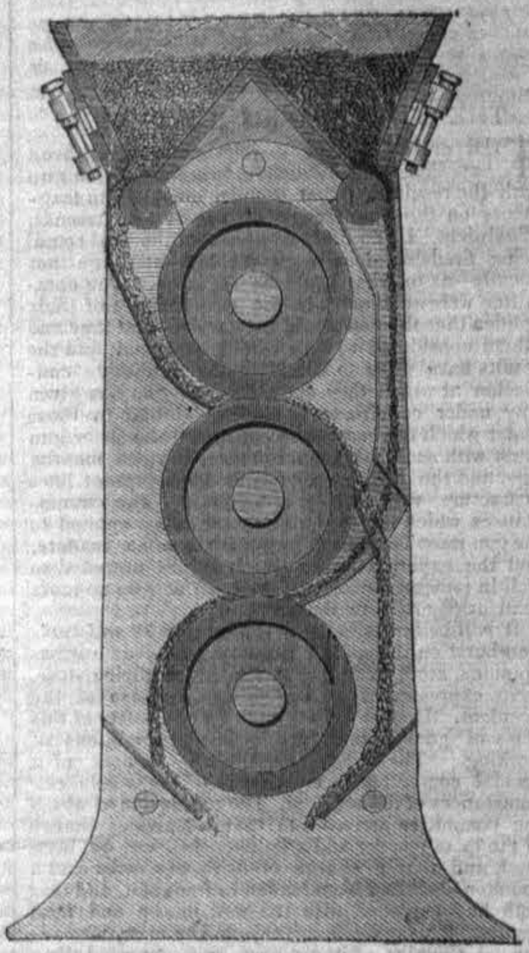

FIG. 2.

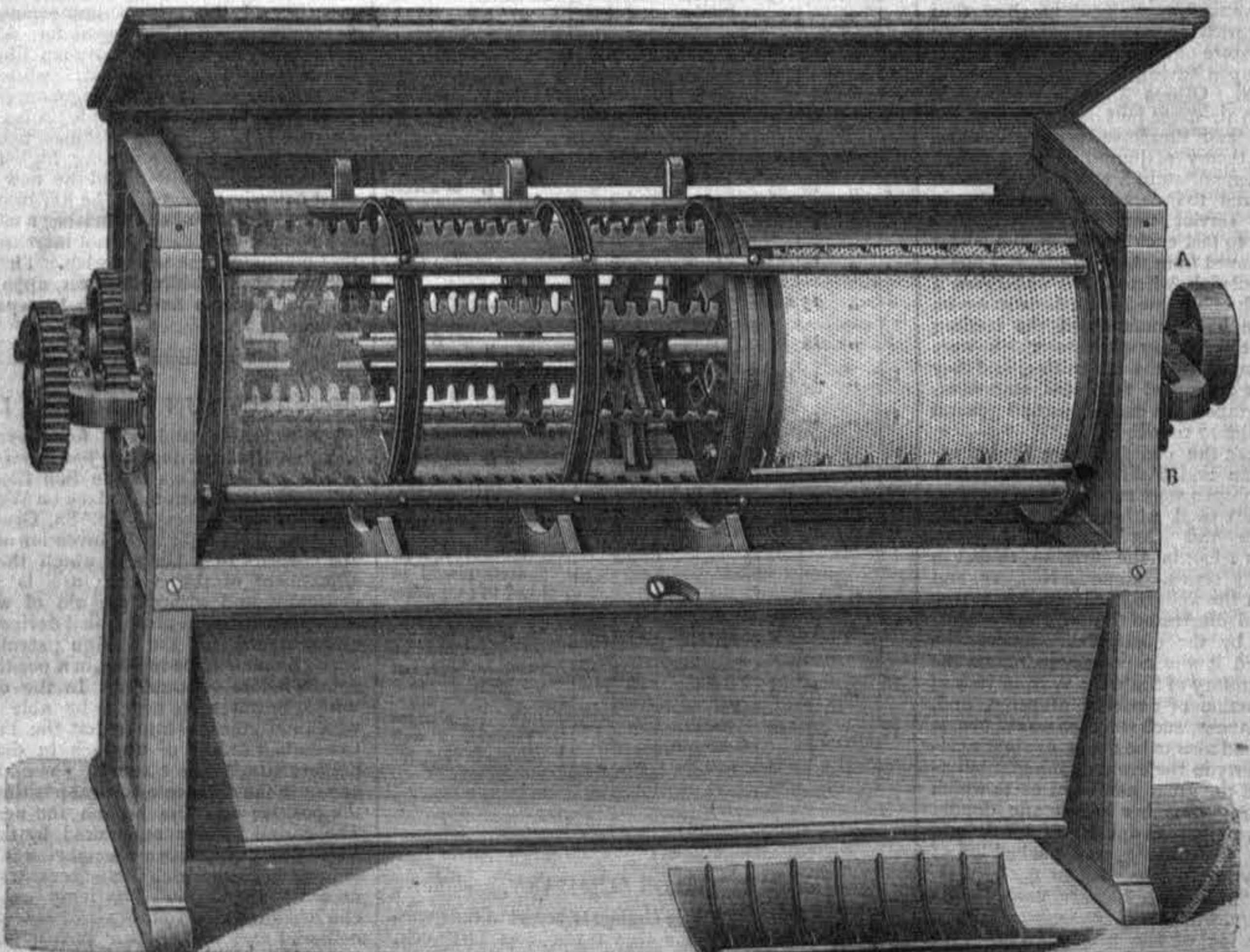

FIG. 4.

bottom of the lamp-post. At the top is a reflector which will receive the rays and project them at a proper angle into the street, diffusing them all around. The street lamps are arranged to be worked from alternating current machines upon Mr. Harrison's system, which is stated to admit of considerable subdivision of the light. This, we are informed, will be exemplified at the next exhibition, when there will be no need for reserve as regards details. The demonstration was conducted by Mr. Thomas Blake, the managing director of the Sun Electric Light Company, whose offices are at 25, Queen Victoria Street. The works are at Sindsley Mill, Worsley, near Manchester, where, we understand, the manufacture of the lamps and carbons is being carried on.

## HUNGARIAN MILLING MACHINERY.

THE steadily increasing importation of Hungarian flour is slowly but surely bringing about a revolution in the English milling trade, by the substitution of steel rolls for mill stones. Roller mills have been employed in Austria for nearly ten years; and the number now at work in that country exceeds four thousand. That they have not more rapidly come into use in England is due to the faulty design and construction of those at first introduced, to the fact that they were not adapted to the special requirements of English milling, and to the proverbial conservatism ofthe national character. With millstones, the corn enters at the middle, and is obliged to make several revolutions before effecting its escape as flour at the circumference, the time occupied being estimated at an average of thirty seconds. The heating to which the flour is thus subjected is liable to transform the gluten, or most valuable portion, into dextrine, if not, indeed, into actual starch, which is well known to be innutritious and indigestible. In addition to this, a portion of the bran is ground to a fine powder, which cannot be separated from the flour by any known process, so that a discoloured, and consequently inferior, product is the result. The germ, also, and the dirt adhering to the crease of the grain, are ground up with the flour, the quality and marketable value of which they certainly do not tend to improve. It thus happens that, to produce fine white flour, even approaching that from rollers, the wheat, if ground with stones, must be of a better quality than if rolls are employed. Indeed, rolls are well known to turn out a better product from an inferior grain than stones with a superior one. Moreover, no heating takes place, as the meal only remains between the rolls for a portion of a second. Besides the improved quality of the flour and the increased yield obtained from a given quantity of wheat, the Hungarian system of milling presents considerable advantages as regards plant and cost of production. Far less power is required to drive the roller-mills, which are easy of erection, and occupy less room. The operation of dressing, or re-cutting, need only be performed at intervals of as many years as days in the old process; and fewer hands are required for a given output.

In our last volume we briefly referred to the milling appliances, on the Hungarian principle, exhibited in action at Kilburn by Mr. Henry Simon, C.E., of Manchester, and we now, by the aid of the accompanying illustrations, fulfil the promies of describing them more in detail. Fig. 1 shows a perspective view, and fig. 2 a vertical cross section of the "trio," or three-high roller mill, designed by Mr. Daverio, and subsequently adapted to the requirements of English millers. By this arrangement, the same effect is produced as with two pairs of rolls in a horizontal plane, while a great reduction is made in the friction, and consequently in the power required to drive. The diminution of friction is due to three causes. In the first place, the abstraction of one roll out of four takes off 25 per cent. Secondly, the friction of the middle roll journals is almost *nil*, owing to an equal pressure being maintained upon it by the top and bottom rolls. And, thirdly, the friction of these latter is transferred to pins of much smaller diameter by anti-friction rollers, which at the same time effect a thorough lubrication. The journals of the top and bottom rolls are carried by bell-crank levers, the *fulcra* of which are the gudgeons, seen a little to the right of the journals. Their pressure on the centre-roll is maintained, and elasticity secured, by adjustable spiral springs, one on each side of the machine; and the adjustment of the rolls in a truly horizontal position is effected by the set-screws and hand-wheels, two of which are seen at each side of the machine. The regulating of the distance apart of the rolls while working, to suit different classes of work and different amounts of feed, and the immediate separation of the rolls, if required, are performed without taking off the pressure, by a lever moving with a stud in a slotted sector, and provided on its fulcrum shaft at each side with an eccentric projection, which acts upon the long arms of the bell-crank levers, and so increases or relieves, at will, the pressure of the top and bottom rolls. This is a very important improvement, as it obviates all difficulty in starting, through a wedge of material forming between the rolls. Again, as the pressure is absolute and independent of the feed, an irregular feed does not affect the position of the rolls, or cause one end to touch, wear unevenly, and produce an irregular sample. Nor is any jar experienced in the event of a sudden cessation of feed. The feed arrangement, which is very ingenious, is shown in the section. Two streams from the double hopper are evenly distributed by fluted feed-rollers, and directed—one of them, between the top and middle roll, and the other between the middle and bottom roll. The latter passes, by means of what is called a "cross channel piece," across or through the ground product from the top and middle rolls. This contrivance was hit upon, after much thought and experiment, to prevent the substance from passing twice through the same roller mill before undergoing a separation, as such double grinding was found to exercise no good effect.

The wheat is first passed through a mill with plain rolls to open out or "crack" the grains; this operation detaches the dirt remaining in the crease, and also the germ, but so small a proportion of flour that 1 per cent. represents the whole of the waste extracted by the wire cylinder. The remaining 99 per cent. is then passed between a succession of plain and fluted rolls, with a separation after each passage, until the bran is quite clean and free from flour, and the resulting semolina or "middlings" sufficiently fine to be reduced to flour between plain rolls. An end view of the fluted rolls, which are of successively diminishing degrees of fineness, is given at fig. 3. The flutes are produced with a twist, by a process analogous to the rifling of gun barrels; and the middle roll, both in plain and fluted rolls, is made to revolve at a slower speed than the others, so that a tearing action is the result. Dr. Kick, of Prague, calculates that the power absorbed in crushing grain between smooth rollers revolving at the same speed is just double that required with fluted rollers and differential speed. Practical experience also goes to prove that the direct pressure given by plain rolls revolving at the same speed, produces one-third less result on middlings than by the same rollers with differential speed. The former arrangement has this additional disadvantage that, instead of meal, cakes are produced which require an additional process to disintegrate them, with further consumption of power. To effect the differential speed of the rolls, only one toothed wheel and two mortise wheels, placed between the bearings and the frame, are employed; so that the bearings are readily exposed, and the wheels work noiselessly notwithstanding their high speed. The hard-chilled rolls last a long time without wear, which is only slight after several years' working; moreover the plain rolls can be re-ground, and the fluted rolls re-cut, at a trifling expense. This a strong argument in favour of the use of steel instead of porcelain rollers, which wear away rapidly and are, besides, not capable of practical use in the fluted form. The advocates of the latter bring a counter charge against steel rolls, to the effect that they continually sweat out carbon and discolour the flour; in fact, as Mr. Simon has happily expressed it, this chemically-combined carbon would furnish an everlasting supply of carbon-atoms, tearing themselves away from their affianced atoms of iron, and walking in single file through an average thickness of half an inch of chilled iron, with the evil intention of contaminating the flour. To this it may be answered that, as the Daverio rolls are only from ¾ to 1 inch thick, thus giving a little elasticity, and weigh only about 80 lb. each, the quantity of carbon they contain is utterly insignificant. Moreover, the carbon present is not free, but in combination with the other constituents, because these rolls are cast in chills, and Dr. Percy states that rapid solidification favours the retention of carbon in the combined state.

The separation of the flour contained in meal, whether obtained by means of rolls or stones, is now generally effected by silk dressing or sieving cylinders, with centrifugal action. The wear of the silk, however, owing to the presence of sharp particles of bran and semolina, has been found so great as to lead, on the Continent, to the use of a preliminary, and even in some cases an inner wire cylinder, This practice, while only diminishing the evil, doubles the outlay and space required; therefore, to meet the difficulty, a centrifugal dressing machine, with silk and metallic cylinders, arranged end to end and combined in one machine, has been devised by Mr. H. Seck, of Frankfort. This machine, which also formed part of the milling plant exhibited at Kilburn, by Mr. Simon, is shown at fig. 4, of the engravings. The smaller of the two parts of the centrifugal cylinder is covered with perforated zinc sheet, and the other with the usual silk cloth. The beaters are caused by spur gearing to revolve at ten times the speed of the cylinder. The zinc end is cased in by tin sheets, a portion of which is shown at the bottom of the engraving, having a screw on their inner surface for conveying the flour and fine "middlings" into the silk part of the cylinder. The material to be dressed is then fed into the first division, where the bran and semolina are returned as "tailings," while only the flour and soft middlings pass into the second portion. Here the flour is dressed through the silk, the coarsest only of the fine middlings being delivered at the end. This machine is suitable for a great variety of products, which it dresses efficiently, while affording a high percentage of fine clean flour. There is a considerable reduction of space and power required, with a saving of from forty to fifty per cent. in first cost. Besides this, owing to improved construction, the putting on of the silk covering is made an easy matter, no loose frames being required. The whole dressing surface is left clear; and the form of beaters facilitates a perfect separation of the meal without causing an excessive current of air, the meal being thrown against the silk in an evenly divided mass resembling a cloud.

There exists in England a strong predilection in favour of what is called "broad and very clean bran," as produced in stone-grinding; this consists, if the truth be told, of the larger portions of the corticle, deprived, not merely of the flour adhering to the inside, but also of the outside coat, which comes off much more easily. Where such bran is obtained, the dirt and silicious matter are ground up with the finer particles, and give the flour a dark colour. Very clean bran is, therefore, incompatible with fine, white, and clear flour; and it cannot be obtained in roller-grinding, because the skin is torn by the fluted rollers into tolerably equal medium-sized pieces, which, however, really possess a higher intrinsic value than the ideal product. Moreover, the roller process has now been so far improved as to produce bran quite free from useful flour, and almost as broad as that made by stones; and any slight temporary loss on this account is a mere trifle compared with the gain in percentage of flour extracted, and its higher value. The products of the last granulating pass will have about 5 per cent. of flour adhering to them, which is removed by the fine - fluted rollers, followed by the detacher. The simple machine shown at fig. 5 occupies only a small space, and requires very little power to drive. It consists of two discs with fluted surfaces, between which the bran passes, being fed up by the worm; and a high speed is given to the discs.

In conclusion, it is claimed that, by this system of milling, at least 70 per cent. of flour, superior in quality to that furnished by stones, is obtained with half the usual power and space required, without the disadvantage of heating. We are informed that the power required to drive a single roller-mill is from ½ to 1 horse-power, and that at Manchester a 10-inch belt serves to transmit the power required for grinding 700 sacks of corn a week, including all the subsidiary operations, with a margin for future extension. Indeed, theory and practice combine to prove that the power required by a good roller plant is only one-half that absorbed for a given production by the old system of stone grinding.

## SHEPHERD'S SECTIONAL BOILER.

THE importance of safety in connection with the generation of steam is so paramount, and should so greatly override all other considerations, even that of cost, that we need no excuse, but rather deem it a public duty, at all times, to direct attention to any invention bearing on the points thus involved. When, however, an invention embodying the elements of both safety and economy comes under our notice, it is doubly desirable that we should place particulars of it before our readers. In this connection, then, we have to notice the internally-fired sectional boiler, invented and manufactured by Mr. James Shepherd, of 22, Brazenose Street, Manchester, and of which the accompanying engraving shows, at fig. 1, an elevation in part section. It will be seen that the boiler is composed of a series of parts, each forming an independent steam generator, but connected with one water supply, and having the same means to receive and convey away the steam, but being at the same time one complete and undivided steam-boiler. The entire boiler is of wrought iron, except the top steam-pipes, and these simply do the work of an ordinary steam-pipe. The bottom cylinders—three in number—are placed horizontally, and are each 2 feet in diameter, fitted at the front ends with manholes, beds and covers, giving easy access for cleaning and examining the lower portions of the boiler. On blocks, riveted to the upper portions of these cylinders, the coned tubes are placed in vertical and consecutive order, forming pyramid-shaped flues or tubes. They are 6 feet 6 inches high, 2 feet diameter at the parallel belt, and 6 inches where they are connected with the cylinders. Though the cones are accessible from the bottom cylinders, each is fitted with a top handhole, thus giving additional facility for cleaning and examination. The arrangement of the cover-lid is simple; it can be removed, and the joint easily made good and

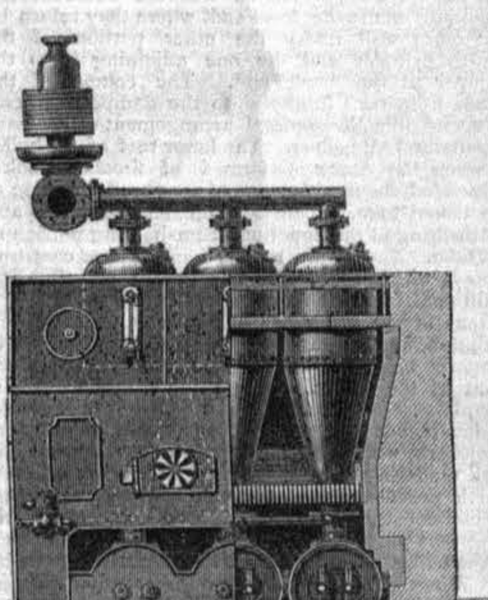

FIG. 1.

steam-tight by an unskilled person, even for very high pressures.

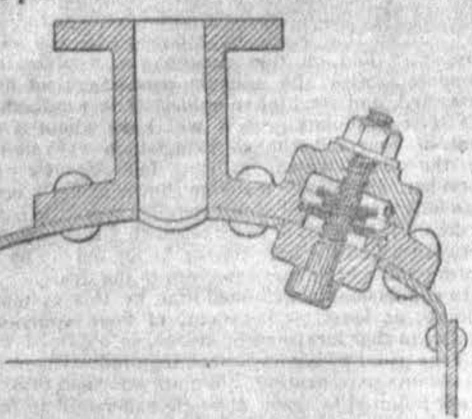

Fig. 2

As will be seen from fig. 2, only one screwing-down bolt is used, being placed directly upon and central to its work; the pull is equal over the area of the cover, and the two faces come evenly and firmly together. The guide-plate, C, gives the proper position for the bolt, and the nut, D, fixes or holds it there during the adjustment of the cover and its final screwing-down. Thus the cover can be removed or replaced without difficulty.

In a transverse direction each set of cones is connected at the top by a 3-inch steam-pipe, and these pipes terminate into one 6-inch main pipe. This being the highest portion of the boiler, the safety-valve and steam stop or junction valve are fixed on the main pipe. The fire-bars are placed in the flues or tubes formed by the cones, just as they are placed in an ordinary two-flued boiler, the only difference being that the flues are conical instead of circular.

The fire-bridges are placed at the end of the fire-bars, and beyond them there is a flooring or covering of iron plates, forming the bottom of the continuing flue and shielding the flanged connections of the cones with the cylinders from the action of the gases. Immediately at the back of the boiler there is a diaphragm wall, with openings opposite the centre of each row of cones; through these openings the gases pass from the furnace tubes, thence under one half the bottom centre cylinder and the whole of the adjoining one to the front end, where they return by the cross wall under the other portion of the centre cylinder and the one adjoining it to the damper at the back end. The course of the gases from the furnaces to the damper is therefore very like the general arrangement of ordinary internally-fired boilers. The lower roof of the boiler between the cones is formed of fireclay blocks, suspended about mid-depth of the parallel portion of the coned tube. This arrangement prevents any overheating of the upper or steam-holding portion of the tube. The upper roof is composed of cast-iron plates, which are easily removed, thus affording additional facilities for examination or repairs. The fittings of the boiler are of the most approved description, and there is only one damper, which is properly balanced and easily controlled from the front of the boiler. The setting of this boiler is of the plainest description, requiring no special blocks or bends, but being composed entirely of ordinary brickwork, which does not touch the boiler at any part, rendering it particularly free from the defects which produce external corrosion. Owing to its special construction the boiler is particularly suitable for export purposes.

The boiler was tested for its evaporative power by Mr. Henry Hiller, C.E., for two consecutive days in March, 1879, with the following satisfactory average results:—

| | |
|---|---|
| Coal consumed per square foot of fire-grate per hour .. .. .. | 13·5 lb. |
| The evaporation of water per pound of coal consumed .. .. .. | 8·56 lb. |
| Average temperature of feed water .. | 50·7 degrees. |

We may add that this boiler is used for daily working pressures up to 150 lb. on the square inch, but it is stated to be equally economical for low-pressure purposes.

## CANVAS FIRE-HOSE.

We have recently had an opportunity of examining the patent canvas fire-hose manufactured by Messrs. Davis and Henwood, of 28, Budge Row, Cannon Street, London, similar to that used by the Metropolitan Fire Brigade, and supplied by the makers to many of our leading engineering firms, steamships, and railway companies. This hose is made of tanned or grey canvas lined with indiarubber; but the mere fact of its being so lined does not constitute either its novelty or its value, inasmuch as canvas hose has been so lined before. In other cases, however, it is found in practice that the force of the water will frequently cause the rubber lining to become separated from the canvas and so choke the hose, thus, in the case of a fire, stopping the supply of water, causing the hose to burst, and otherwise delaying the extinction of the conflagration. But this firm have overcome this fatal defect, and by their process of manufacture such a perfect union is effected between the rubber and the canvas that the former will not strip off nor become detached from the latter. The new hose is found to be far superior to the leather hose, it being claimed for it that it is strong, light, pliable, durable, waterproof and cheap. Its strength is shown by the fact that it will bear a pressure of from 250 lb. to 300 lb. to the square inch, while its lightness and pliability are demonstrated by its being one-third the weight of leather, and that a great length can be carried and easily handled by one man up a ladder or a flight of steps. Its durability has undergone a thorough test by the Fire Brigade, and it shows no signs of decay, the absence of which is ascribed to the tanning, which kills the insects that destroy an ordinary flax hose, while it protects the new one from the action of damp or mould. A most important advantage of the invention is that it is waterproof. It is thus kept dry, and is, therefore, not liable to damage anything over which it is drawn. Leather hose has to be greased periodically to prevent it becoming hard and cracking, and it is thus apt to spoil things with which it is brought into contact. Its cheapness arises from the circumstance that it is much more durable than either flax or leather, and it involves no oiling, nor any other expense of maintenance. Towards the close of last year the new hose was submitted to a public trial, although some 80,000 feet of it had been in use by the Metropolitan Fire Brigade for the past three years. Upon the occasion of the trial, twelve lengths of the hose were tried with the view of ascertaining its capability of withstanding a pressure of 300 lb. per square inch, although the ordinary brigade-pressure is far below this. The firemen pumped into the several lengths of hose to be tested the required quantity of water from a hydrant, and all of them came out of the trial in the most satisfactory manner, except one length which burst at 290 lb. pressure.

## OCCASIONAL NOTES.

### TWO STRINGS TO THE BOW.

The *Times*' Paris correspondent states that on Friday last week, whilst an immense tract of ice in the Loire threatened a destructive inundation in the event of a thaw, the curé of Saumur, at the instigation of his bishop, applied to the mayor for permission to try the effect of a religious procession from one of the churches of that town to the other. In this case the danger of the situation had been duly appreciated by the Government of France, and the best engineering ability of the country engaged to ward off the impending disaster. So the mayor reminded the curé that such processions as he proposed were contrary to law, adding that his (the mayor's) fellow-citizens would be obliged to him for "leaving science alone to seek means of defending them against the peril threatening, but already partially warded off by it." The curé retorted by inviting his flock to supplications within the church, so that they should "not leave to science alone the task of saving us, but enlighten and inspire it, and directly intervene in the possible event of *savants* and strong men suddenly coming to the end of their science." Of a somewhat similar opinion were those tribes on the skirts of the Caucasus, who used to practise, and unless they have been converted to the Russo-Greek faith in the customary Russian fashion by the booted apostles of the Czar, still do practise the rites both of Islam and Christianity; so that they may be safe, whichever ultimately turns out to have been the true faith.

### LONDON FOGS.

November is the month of fogs in London; but last November the atmosphere was comparatively free from these uncomfortable visitants; and during the last and present months we have had them of more than usual intensity, and all over the country as well as in London. The winter has been so far a dry one, but excess of moisture has apparently very little to do with the "London particular." Its origin is disputed; the prevailing opinion, however, is that it is generated in the marshes which border the lower reaches of the river. Dr. Frankland maintains that the persistency of fogs in large towns is due to a coating of coal oil, the produce of our numerous and wasteful fires, upon the minute particles of water which compose fog, and which prevents the evaporation of the water. So that by substituting smokeless coal, coke, or gas for bituminous coal in domestic and manufactory fires, fogs would neither be so dense nor so lasting. One of the most noticeable effects of fog is the way in which it intercepts the light from the street lamps. The electric light, as many Londoners may have noticed, has much greater penetrative power in such cases. It is true that a correspondent of *The Times* recently asserted that the gas-lamps on Waterloo Bridge gave more light during the late fogs than the electric carbons; but he was promptly set right by other contributors, who probably saw the latter without the intervention of gas shares as well as fog.

### TRAMWAYS.

The railway grew out of the tramway, but it is only a few years since the latter has been adapted to passenger traffic. During the last decade, however, in spite of obstructions of all sorts, there has been a great expansion of the tramway, or, as the Americans term it, the horse-railway system. But from some cause not quite apparent, the cost of the permanent way has been greatly in excess of what might have been reasonably expected. There has been no site to purchase—nothing, so far as appears on the surface, but the cost, in materials and workmanship, of laying down a line of light rails along the public street or road; and yet, as we are told, the average expenditure on the permanent way has been between twelve and thirteen thousand pounds per mile. One London company expended £761,800 on 32½ miles; and the average cost of maintenance is as much as £200 per mile per annum. The initial expense, coupled with more objectionable causes, although the traffic is very great—a hundred and fifty million passengers passed over the British tramways last year—has kept the average dividend down to 4 per cent. per annum. The introduction of the locomotive on these lines would of course involve a very great additional expense; yet it is to this that shareholders are trusting for the improvement of their property. But if there is any truth in the statement that Dr. W. Siemens has succeeded in adapting electricity to locomotive purposes, the tramway itself must be discarded; for this project involves the construction of an elevated railway, which will fully provide for internal communication in cities, and render both tram-car and omnibus obsolete.

### THE SUPPLY OF FISH TO THE METROPOLIS.

One of the gravest scandals in connection with the Corporation of London is the way in which the fish market is managed. There are annually received and distributed through the market at Billingsgate nearly two millions of tons of fish, but that does not at all represent the quantity the great metropolis could profitably consume. The market, to begin with, is much too small for the trade, and it is, besides, controlled, like other markets, in spite of free trade, by a "ring," which thus establishes a virtual monopoly; and rather than break their prices the dealers allow immense quantities to spoil. During the last two months the Fishmongers' Company seized and destroyed twenty-two tons as unfit for human food, which, however, probably represents but a small proportion of the wasted supply. It is now proposed to build a new fish market on the site of St. Katherine's Docks, the effect of which would be greatly to relieve the traffic of Lower Thames Street and the adjacent thoroughfares, and, what is of more importance, probably be the means of breaking up the "fish ring," and constitute another good work to which the Corporation might trust when their day of reckoning comes.

### AVOIDABLE WASTE OF LIFE AND PROPERTY AT SEA.

Mr. Plimsoll, in addressing his constituents on Monday evening, brought a number of grave and well-founded charges against the Government in connection with the preventible loss of life and property at sea. He complained that they had refused to enforce the compulsory survey and repair of disclassed vessels, a proceeding which, on the face of it, appears essentially necessary; and he significantly added that the power which was, instead, given to the Board of Trade to stop ships declared to be unseaworthy, was seldom used, and scarcely ever against the owner of a large ship, only in the case of such small flies as lighters and such-like craft. The load-line, he complained, was also illusory. But the gravamen of his charge was in relation to the great sacrifice of life and property during the past winter from the wreck of grain-laden vessels. In 1879, chiefly in the last four months of that year, thirteen grain-laden steamers have been lost, six of them not having been heard of or seen since the day they sailed, and all fully insured, even to the importer's profit. The crews of these ships numbered from twenty to thirty-five each, and they carried on an average 99,000 quarters of grain, which was a direct loss to the nation, besides that of the seamen. The main cause of these shipwrecks is the shifting of the cargo during a gale, which can only be effectually prevented by stowage in sacks, involving very little, if any extra cost, for the sacks can be sold afterwards. The usual precautionary measure adopted is the placing of what are called shifting boards through the grain; but as Mr. Plimsoll has found, from the inspection of a large number of grain-laden vessels in the London docks and elsewhere, that these boards never descend more than about 4 feet from the surface, and are otherwise wholly inadequate to prevent shifting in a heavy sea, the protection which they afford is very slight indeed. The enemies of the Government are rallying everywhere; and, to put it on the lowest ground, by intervening in this and other similar cases for the protection of the weak against the selfish and strong, it would materially strengthen its position; at all events, it would perform a manifest duty by thus fulfilling the main purpose of its existence.

### WEATHER PROBABILITIES.

Whether the revival in trade which has commenced will go on and extend depends in a great measure on the next harvest. If we are to judge from the past four months, there is hope that in the present year we shall have no recurrence of the persistent rain, which, "raining every day," rendered vain the labours of the husbandman. From the letter of a Birmingham meteorologist, published in *The Times*, we learn that during the past four months the rainfall in that district has only been 4·27 inches, while the average for the last 19 years was 10·70 inches, and that the canal reservoirs in the neighbourhood are getting very low. There is some reason, therefore, to trust that we may have reached the end of a cycle of twenty years' wet weather; and looking to its effect on the crops in the later years of that period there may thus be ground for congratulation; but the writer points out that if this four months' drought had occurred during the summer months serious inconvenience and loss might have resulted; and he hints that the extent, excessive and unnecessary in many cases, to which agricultural drainage has been carried of late may have serious results, with a reduced rainfall, both to agriculture and the public health.

## THE SOCIETY OF ENGINEERS.

The Society of Engineers has just entered upon the twenty-sixth year of its useful and honourable career, having been founded in 1854. During the quarter of a century of its existence, it has, like all other associations, known something of change. The depressions which have occurred in the engineering profession have of course made some mark upon it in restricting at times the inflow of members. But through good report and evil report the Society has lived on and thriven, and to-day finds it in a position financially sound and numerically strong. It has always enjoyed the advantage of a good working council, who have had its interests at heart, and it has ever been happy in its choice of President, whilst its executive officers have been no whit behind in manifesting that personal interest in its affairs which is so essential to the success of any professional institution. In its constitution it is, so to speak, cosmopolitan, for it includes in its ranks, members of every branch of the engineering profession. Hence its proceedings embrace a very wide and varied field, inasmuch as papers on every class of engineering subjects are read and discussed by it. It was established solely for the advancement of engineering science and practice, and in furtherance of these objects, in addition to the papers read during the session, visits are made during the vacation, to works of professional interest. By these and by other similar means, and not less by reason of a strong feeling of unanimity which has ever pervaded the whole body of members and associates, the Society of Engineers, has always been able to maintain a prominent position, and to command universal respect. This it cannot fail to continue to do whilst conducted upon the principles for which its management is distinguished.

The first ordinary meeting of this Society for the present year was held in its hall in Westminster on Monday evening last. At the conclusion of the routine business, the retiring president, Mr. Robert Paulson Spice (who has just concluded his second year of office), presented the premiums of books which had been awarded to the following gentlemen for papers read by them during the past year, viz., to Mr. C. J. Alford for his paper on the Mineralogy of Sardinia, and to Mr. J. Andrews for his paper on the Strength of Wrought Iron Axles. The premiums having been presented, Mr. Spice vacated the chair, and introduced the president for 1880, Mr. Joseph Bernays, to the meeting. Mr. Bernays then proceeded to deliver a long and highly interesting inaugural address of which we now give a full abstract.

### Inaugural Address.

After recording his great appreciation of the honour done him by the members of the society in electing him their president, and urging the claim of the society as being a medium for the further education of the junior members of the profession, and a means of interchange of thought and opinion for those of riper practice, he asked the members to attend in good numbers at the ordinary meetings, and to increase the scope and efficiency of the society by introducing new members. He next explained that the principal object he had had in view in the preparation of his address was to give an idea of the position of the Society of Engineers in relation to the profession at large, forming, as it did, a link between other professional and scientific bodies of a more specialist character; a proposition which he proceeded to prove by showing that the papers read and discussed at the meetings, and the visits paid to interesting works during the summer vacation in the past year, were closely connected with many of the most important subjects that occupied the minds of the profession in the present day.

The first subject mentioned was that of railways, in connection with which there had been two papers read—one by Mr. Thomas Andrews, on "The Strength of Wrought Iron Axles," and one by Mr. E. D. Barker, on "Hydraulic, Continuous, and Automatic Brakes." In the course of his remarks on these the President referred to an improved method of testing railway axles by subjecting them to a similar class of strains to which they are exposed when in use, the testing strains being made higher than the working strains in a predetermined ratio. With regard to continuous brakes, he urged upon railway companies the duty of applying such in much greater numbers than they had hitherto done, with the view to preventing accidents, inasmuch as what may previously have been termed an accident, with some show of reason, can no longer be put under that category, once adequate means of prevention being known. He further suggested that it might be quite practicable to entirely separate the passenger and goods traffic on our main lines, line-stations, management and all, which would not only be the means of almost entirely getting rid of disasters, but might be found a good investment without interfering with the dividends of the present railways as passenger lines.

Tramways and roadmaking were next considered, on the basis of two papers, the one by Mr. Wilkinson Jones, on "Modern Tramway Construction:" the other by Mr. Charles E. Hall, on "Modern Machinery for Preparing Macadam for Roads;" and it was insisted on that the substructure of a tramway, as also that of the whole road through which it runs required the most careful consideration, whilst perfection would probably not be arrived at until the tramway and the road were treated as one indivisible whole. It was further urged that macadamised roads should be abandoned in towns, and be used only for country roads and lanes.

Mr. Bernays then referred to a paper on "Sewage Disposal," read by Mr. H. T. Robinson, M.I.C.E., giving a short *resumé* of its contents which embraced both irrigating and deodorising processes, touching upon constant water service and other matters, and stated that he fully agreed with the author in his opinion that no general rule can be laid down as to the best method of treatment in each case, which should be left to competent authority to decide.

The last two papers referred to by the President were one "The new Pits and Hauling Machinery for the San Domingos Mines in Portugal," read by himself, and one on "The Mineralogy of the Island of Sardinia," by Mr. C. J. Alford. According to the latter gentleman, the island abounded in mineral wealth, but was not properly exploited, owing to the indifferent mining laws at that place. Amongst the materials found in the island was also a small quantity of iron pyrites, an ore extensively raised at the San Domingos Mines previously mentioned, which gave the President an opportunity of speaking at some length about Mr. Hollway's new process of reducing such ores by allowing the sulphur contained in them to act as fuel, in combination with a powerful blast of air. He next alluded somewhat in detail to the progress made in the treatment of phosphoretic iron ores by the Thomas and Gilchrist process of dephosphorisation, which, during the past year, had for the first time been carried out on a practicable scale at Messrs. Bolckow, Vaughan and Co.'s works at Middlesborough. It appeared from Mr. Thomas's own figures that his process was only 5s. per ton of manufactured steel dearer than the ordinary Bessemer process, whilst the difference in the price of Cleveland pig-iron, which he used, and of hematite pig, generally employed, was at least 55s. per ton in his favour, so that steel produced according to his invention would cost fully 50s. less per ton than it had cost hitherto. Such a difference in price would naturally lead to a revolution in the steel trade; but the President cautioned his hearers against being too sanguine in their expectations of an enormous increase in trade on that account. Other nations also had possession of large deposits of phosphoretic iron ores, which, through the new departure in their use, would naturally be thrown on the market, and thus operate against our own chances.

The vacation visits were next alluded to, embracing excursions to the Providence Ironworks of the Messrs. Cutler at Millwall, the Millwall Docks adjoining, the Victoria Docks Extension Works, the Telegraph Cable Works of the Messrs. Siemens Brothers at Charlton, and the Artificial Stone Works of Messrs. Bateman and Co. at East Greenwich, at each of which places the Society was most hospitably received, and the members were afforded every facility for examining what was most interesting and notable in each. The record of the doings of the Society during the past year, and of some outside matters, relating thereto having been completed, the speaker expressed the hope that he had proved to the satisfaction of the meeting that the Society of Engineers by keeping well up with the engineering problems of the day, honourably and usefully filled the position which it had been created for. The Society, owing to depression of trade and other causes, had had uphill work for some years back; but as times improved he had every confidence in the Society continuing to hold its own in the future as it had done in the past. Not the least of the inconveniences which they had suffered from was the loss during the last year of the services of their excellent secretary, Mr. Perry F. Nursey, who had been called to a more important position in a new sphere of action. On his retirement they had presented him with a testimonial as a slight token of their respect and esteem, whilst offering him at the same time a seat on the council board, as they had since made arrangements with Mr. Alfred Elgar as their future secretary. The President regretted that there was not time left for him to refer to a few other interesting subjects as he had intended, and he concluded as follows:—"In reference to the subject of engineering education, I may, perhaps, in conclusion crave permission to transfer to these pages a saying of the late Professor Redtenbacher of the Engineering Schools at Carlsruhe, which will bear repetition. I should premise that Professor Redtenbacher, some twenty to twenty-five years ago held very much the same position in that the late Professor Rankine held in this country. He had been an engineer in large practice before he obtained the professional chair at the Polytechnicum, where he was ultimately raised to the directorship, a post at present occupied by our honorary member Dr. Grasshoff. Redtenbacher's labours were recognised far beyond the confines of Germany, and he was always very anxious to impart to his pupils those fixed and clear principles of mechanics, which were afterwards to form their guide and standard during their professional carrier. His motto may be rendered into English thus: 'The general principles of mechanics constitute the only true and lasting basis, not only for engineering science, but for the whole vast realm of sciences, penetrating into the mysteries of nature.' Or in other words, nothing can be undertaken in this world of ours, no action or reaction can take place which cannot finally be reduced to a mechanical problem; and whether a science is called physics or chemistry, whether we combine or dissolve bodies, whether it is a question of heat or light, or electricity, whether we consider the motion and interaction of the stars, the movements of the winds and of the waves, the growing of plants, and even the descent and evolution of man, the more nearly the explanation of a natural phenomenon approaches a mechanical solution, the more accurate such explanation is likely to be. And as it is the engineer, in the widest sense of that term, who will ultimately have to deal with every natural phenomenon in one form or another, in his endeavour 'to make the forces of nature subservient to the uses of man,' it is the young engineer to whom the key of the whole situation must be given by inculcating him at the very commencement with sound principles of mechanics."

## ON FRICTION AT HIGH VELOCITIES.[*]

### First Report of the Committee.

*Members of the Committee.*—E. A. Cowper, Esq.; Capt. Douglas Galton, C.B., Hon. D.C.L., F.R.S.; Dr. John Hopkinson, F.R.S.; Professor H. C. Fleeming Jenkin, F.R.S.; John Ramsbottom, Esq.; Lord Rayleigh, F.R.S.; Professor A. B. W. Kennedy (*Reporter*).

The subject with which this committee has to deal has been defined as "friction at high velocities, specially with reference to friction of bearings and pivots, friction of brakes, &c." As the essential question involved in this is the influence of velocity upon frictional resistance, it has appeared neither necessary nor advisable that the reporter should give any special account of what has been written upon the subject of friction generally. Unfortunately, however, the results of his examination of the numerous works and papers bearing upon the subject to which he has had access have been chiefly negative, so far as relates to the particular question in hand. Very little work appears to have been done in connection with this question; and even of what has been done much seems inapplicable—on account of difference of conditions—to the ordinary work of the mechanical engineer.

A difference has long been recognised between what has been called static friction, or the friction of rest, and dynamic friction, or the friction of motion, the coefficient in the former case being, in many instances, much higher than in the latter. The recent experiments of Professor Fleeming Jenkin in connection with this matter, although made at the opposite end of the scale of velocities to that about which the committee is now chiefly concerned, have great interest in connection with the general question of velocity and friction. By experimenting at extremely low velocities, he has shown[†] that in certain cases, where there is a very marked difference between the two coefficients mentioned, the coefficient of friction decreases gradually as the velocity increases, between speeds of 0·012 and 0·6 feet (0·0036 and 0·183 metre) per minute; and his experiments indicate a probability of a continuous rather than a sudden change in the value of the coefficient between the conditions of rest and motion. In cases where there is little or no difference between the coefficient of rest and motion, no difference was found at the velocities between which he experimented. His experiments were made with a very small steel spindle of 0·1 inch (2½ millimetres) diameter only, resting in rectangular V notches, the pressure being constant, and due to the weight (86 lb. = 39 kg.) of a disc carried by the spindle, and revolving with it.

Professor A. S. Kimball has made a number of experiments[‡] upon the question of velocity and friction. At common, but somewhat slow apeeds, he finds the friction between pieces of pinewood to decrease rapidly as the speed increases. With a wrought-iron shaft of 1 inch (25 millimetres) diameter, working in a cast-iron bearing well-oiled, an increase of velocity of rubbing from 6 to 110 feet. (1·8 to 33·5 metres) per minute caused the coefficient of friction to fall to 0·3 of its first value. The pressure in this case was about 67 lb. per square inch (4·7 kg. per square centimetre). Other experiments on lubricated journals at smaller pressures gave a diminution of the coefficient from 0·15 to 0·05, as the velocities increased from 1 to 100 feet (0·3 to 30 metres) per minute. At such slow speeds as from 0·59 to 2·2 feet (0·18 to 0·67 metre) per minute, a similar decrease was found; while at the still lower velocities of from 0·002 to 0·01 feet (0·0006 to 0·003 metre) per minute, the friction *increased* with the velocity.

Professor R. H. Thurston has carried out a number of experiments to determine the effect of changes, not only in velocity, but also in pressure and temperature, upon the fractional resistance in lubricated bearings[§]. His conclusions are that the coefficient at first decreases, but after a certain point increases with the velocity, the point of change varying with the pressure and the temperature. At a pressure, for instance, of 100 lb. per square inch (7 kg. per sq. centimetre) and a temperature of 150° F. (65° C.), the minimum value of the coefficient is reached at a speed lying between 100 and 250 feet (30 and 75 metres) per minute; while at the same pressure, but at a much lower temperature (apparently) the value of the coefficient increases continuously from 30 feet (9 metres) per minute, the lowest velocity tried, up to 1200 feet (360 metres) per minute. As the general result of his work, Professor Thurston has come to the conclusion that for a cool and well lubricated bearing the coefficient of friction increases with the velocity, and approximately as its fifth root; at all speeds exceeding 100 feet (30 metres) per minute. It is much to be regretted that Professor Thurston has published no information about his very important experiments, in this part of the subject, except a few tables of epitomised results. Neither the sizes of the journals tested, the number of tests made, nor any particulars as to the variation of the experiments among themselves are given, and very few details as to the way in which they were carried out. Until this information is made accessible (as it is to be hoped it will be made) it is not easy to estimate the degree of importance to be attached to these results.

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[*] Reports to Research Committees of the Institution of Mechanical Engineers.

[†] Royal Society, Proceedings, 1877, p. 93

[‡] "American Journal of Science," 1876 and 1878; also Thurston's "Friction and Lubrication," p. 182, *et seq.*

[§] "Friction and Lubrication," p. 185. American Association for Advancement of Science, Aug. 1878, p. 61.

The well-known experiments of Poirée and Bochet[*] show that between velocities of 900 and 3600 feet (270 and 1080 metres per minute the coefficient of friction both of wheels and shoe brakes, skidding on rails diminished very much—approximately (in the former case) from 0·2 to 0·13. The surfaces were of course quite unlubricated.

The recent experiments of Captain Douglas Galton and Mr. Westinghouse, described by Captain Galton in his papers read before the Institution,[†] afford very valuable information as to the effect of changes of velocity upon the fractional resistance between brake-blocks and wheels, and also as to the simultaneous variation of the coefficient of friction with the intensity of pressure, or pressure per unit of area. These experiments throughout showed a very remarkable diminution of the coefficient of friction with increase of speed over the very large range of from 400 to 5300 feet (120 to 1600 metres) per minute. The nature of the appliances used, however, permitted observations to be made only for about 30 seconds consecutively; and it was found that during this time the coefficient of friction always rapidly. This decrease must of course cease after some time—apparently after a very short time—and the question arises, as was suggested by the Reporter in the discussion on one of Captain Galton's papers, whether the difference between the fractional resistances at different speeds would still remain when these resistances had taken up their lowest values, or would then have disappeared. So far as can be judged from plotting out Captain Galton's results,[‡] the difference would remain. From working out a number of these brake experiments, the reporter found that the coefficient of friction was sensibly *less* at higher than at lower pressures, and that the coefficient of friction between the wheels and the rails—where the intensity of pressure might easily be seventy or eighty times as great as on the brake blocks—was less than a third of that between the wheels and the brakes. From Professor Thurston's experiments with journals there appears the notable result that, while this is substantially corroborated for ordinary velocities, and loads, there comes always a point (varying irregularly in the different cases and with different lubricants), after which increase of pressure increases the coefficient of friction, this change being more marked in the case of the lower velocities. The particular point at which this change occurs seems also to be partly dependent on the temperature. Within ordinary limits Professor Thurston takes the friction to vary *(ceteris paribus)* inversely as the square root of the pressure per unit of area; but this conclusion is very far from representing the average results of those sets of experiments which he has selected for publication.

No very large number of answers have been received to the enquiries sent out upon this subject. Of those which have come in, the most interesting are (1) a letter from Mr. Pearce of Cyfarthfa, and (2) a letter from General Morin. The former gives particulars of indicators tests of a rolling-mill engine running empty at different speeds, from which it appears that proportionately a much smaller power was required to drive the engine at a high than at a low speed. The experiments are not of such a nature as to allow any general conclusions to be drawn from them; but they have considerable intrinsic interest, as relating to a form of experiment easily made, and the result of which, noted in a sufficient variety of cases, would afford really valuable information. General Morin's letter is specially interesting, as coming from such a veteran worker in the subject of friction as its writer. He disclaims altogether any notion that from his original experiments laws of friction could be laid down for conditions outside those under which he worked; and sees no reason to doubt that under such high velocities as often occur in practice the coefficient of friction may be considerably reduced. He thinks that an apparatus somewhat similar to that which he used, but modified in detail, would probably be the most convenient for carrying out further experiments. General Morin's letter is appended to this report.

The chief experiments made directly in connection with the subject under the consideration of the Committee have now been cited. From them it may be taken as established that, even at quite ordinary speeds, the value of the coefficient of friction between different varieties of iron or steel is sensibly changed by changes in the velocity of rubbing. For dry rubbing surfaces there can be little doubt that this change is a continuous decrease as the velocity increases up to the limits of the experiments made; for lubricated surfaces, of the form of ordinary bearings (having, however, pressure on both sides of the journal), Thurston's experiments point to the conclusion that at some point the coefficient ceases to decrease with increasing velocity, and begins to increase again. This conclusion can hardly be accepted as final without confirmation. It has as yet been found only by one experimenter, and his results are in many points anything but regular. But at the same time no other experiments have apparently been made with lubricated bearings at anything like the speed (1200 feet or 360 metres per minute) up to which he has worked.

Besides the general conclusions that the coefficient of friction is greatly affected by the velocity of rubbing, the existing experiments also show that it is greatly affected by the intensity of bearing pressure; and they raise some probability that the effect of altering the pressure is different at different speeds. It will hardly be possible therefore, in carrying out any experiments which may be thought advisable upon this subject, to dissociate the question of varying pressure from that of varying velocity. In working with lubricants it is also clear that the temperature very much affects the coefficient of friction; but there is very little evidence as to the effect of ordinary changes of temperature upon dry bearings.

Alex. B. W. Kennedy, Reporter.

## APPENDIX.

[*Translation.*]

Conservatoire des Arts et Métiers,
Paris, 15th March, 1879.

Dear Sir,—The results furnished by my experiments as to the relations between pressure, surface, and speed, on the one hand, and sliding friction on the other, have always been regarded by myself, not as mathematical laws, but as close approximations to the truth within the limits of the data of the experiments themselves. The same holds, in my opinion, for many other laws of practical mechanics: such as those of rolling resistance, fluid resistance, &c.

It has therefore been no surprise to me that, in experiments on the resistance to the sliding of skidded railway wheels over rails, this resistance has appeared to diminish at higher speeds. The vibrations and strains produced in such cases would moreover occasion disturbances such as would wholly change the results.

For journals revolving in stationary bearings, it is natural that, as the efficiency of the lubrication is affected by the speed, the friction should be so also.

In the case therefore of loads, surfaces, or speeds, which largely exceed the limits of those that have formed the subject of my own investigations, I agree with the Institution of Mechanical Engineers that it would be well for further experiments to be tried.

But after mature consideration I am of opinion that the question might be solved by an apparatus of a kind similar to the one I made use of, as described (page 13, *et seq.*) in the paper published in 1838 by the Academy of Science; provided that the new experiments were tried on a larger scale in regard to weight, diameter, and speed.

In the apparatus referred to, the rotary dynamometer, which was the first of its kind, was mounted direct on the axle that was being experimented upon. It would be better that it should be separate from it, and that the axle should be driven by a belt.

The kind of rotary dynamometer that I have subsequently employed, of which there are several models in the Conservatoire, is very convenient for these experiments, and can be used for high speeds. It would afford greater facility for applying sufficiently heavy loads.

The diameter of the bearings should be much greater than is required for strength, in order that a sufficiently high surface velocity may be obtained with a moderate speed of revolution.

For experiments made without any lubrication, anomalous results arising from wear produced by long-continued friction of the same surfaces might be avoided, if instead of fixed bearings an annular bush surrounding the journal were employed, which by some easily contrived arrangement might be shifted circumferentially at pleasure, either with a continuous movement or at intervals.

The above are the suggestions that at present occur to me to offer in regard to arranging further experiments on the friction of axles in their bearings.

If any scheme for an experimental apparatus in accordance with these ideas be submitted to me by the Institution, I shall have much pleasure in examining it and giving my opinion upon the arrangements proposed.

I am, Dear Sir,
Yours very truly,
General A. Morin.

Walter A. Browne, Esq., Secretary,
Institution of Mechanical Engineers, London.

# ON THE HARDENING, TEMPERING, AND ANNEALING OF STEEL.[*]

(CONTINUED FROM PAGE 79.)

### IV.—*Hardening of Steel.*

JULLIEN holds that carbon in contact with iron at cherry-red heat becomes liquid, and is absorbed like water in a sponge, like oxygen in liquid silver, or like gas in porous bodies; cooled slowly, the carbon becomes amorphous, and the steel becomes soft as iron; cooled quickly, the carbon crystallises to depths proportioned to the energy of cooling, and steel becomes diamond set in iron. In your Committee's opinion this theory, even if it accounts for the hardening of steel, does not account for tempering. What takes place when hardened steel is heated and passes through all the gradations of hardness indicated by their characteristic colours! Jullien quotes Berzelius as stating that when a saline solution, saturated or not, is allowed to cool quickly almost to the congealing point, the periphery which is first cooled becomes less saline than the centre; until at last, when the entire mass has solidified, the dissolved salt is found concentrated in the centre. From this fact he infers that two bodies dissolving each other, and preserving their independence in solution, must produce solid compounds of varying properties according to the rate at which cooling takes place. Furthermore all solid bodies are susceptible of two different molecular structures, dependent on the rate of cooling from the fluid state; but this rate of cooling does not produce the same results on all. Thus gold, silver, and copper, if cast in chills, yield a fibrous structure, while, if cast in sand moulds, they exhibit a crystalline fracture; and the fibrous structure can be changed into the crystalline by a temperature short of fusion. Carbon and glass behave quite otherwise. Diamond, exposed sufficiently long to a high temperature in a covered crucible, becomes amorphous or graphite: hence it may be concluded that, if it could be taken liquid and subjected to energetic cooling, it would crystallise; while under slow cooling it would become graphite. Glass, taken liquid and submitted to energetic cooling, crystallises; but when annealed, it becomes amorphous or ceramised. Rupert's drops, which are transparent crystallised glass, become opaque if heated for a long time. He therefore considers that a mixture of iron and carbon, if cooled quickly, becomes hard because the carbon crystallises into diamond; while, if it is cooled slowly, the carbon remains amorphous and comparatively soft. Chilled grey cast iron has a mottled band between the chilled and unchilled parts; this is the zone where the carbon is partly crystalline and partly amorphous. Gruner considers that carbon is dissolved in hot iron: that when cooled slowly the carbon has time to separate as graphite, but when cooled quickly there is no time for separation; and white chilled iron instead of grey cast iron is the result. Soft and hard steel show a similar difference though to a less degree. Barba and Akerman consider that the compression resulting from rapid cooling is the cause of a greater amount of carbon being retained in solution, and prevented from separating as graphite. Your committee find it difficult to accept this theory, because the compression of the internal portion of a piece of steel is caused by the contraction of the outer layers; and these, therefore, must be stretched, as indeed it is well known that they are. But in hardened steel the outer layers, which were most energetically cooled, are the hardest, although they must have been, and probably are, in a state of tension. Akerman, however, considers that compression, or forcing together of the particles, the amount of which is dependent on the rapidity of cooling, produces hardening; and that the intensity of this hardening depends on the compactness of the material and its limit of elasticity. By the way of proof he states that cold-working, rolling and wire-drawing produce similar results.

### V.—*The Molecular Changes that occur in Hardening, Tempering and Annealing.*

The theory announced by Chernoff in 1868 to the Imperial Russian Technical Society appears to explain in a satisfactory manner the molecular changes that take place in steel when subjected to changes of temperature. His view is that:—(1) There is a certain temperature, *a*, such that steel of whatever quality will not harden if heated to any temperature below *a*, and energetically cooled. (2) There is some higher temperature, *b*, above which steel changes from the crystalline to the amorphous condition. (3) If heated to a temperature between *a* and *b*, steel may harden, but does not change its structure, whether cooled quickly or slowly. (4) If heated above the temperature *b*, and up to the melting point, steel has a wax-like structure, is incompressible, and tends to crystallise into larger crystals if left to cool slowly undisturbed, but into smaller crystals if hammered or if rapidly cooled. Fine grain is essential to good, tough steel; hence, by heating up to the temperature *b*, so as to produce the amorphous condition, and then cooling suddenly to below *a* in oil or water, good steel can be obtained. The temperatures *a* and *b* vary with the nature of the steel. Chernoff illustrates his views by reference to the behaviour of alum undergoing crystallisation; and the close reasoning of his remarkable paper carries a strong conviction of the correctness of the views he advocates. There are abundant illustrations of his theory to be found in the many writers on steel who have been consulted. Thus Hackney states that quenching mild steel improves its tenacity and ductility. Riley expressed an opinion that it was not so much the percentage of carbon as the way in which the rails had been cooled that should be taken into consideration, when two rails of the same chemical composition differed in hardness. Barba states that annealing should not be done at too high a temperature, otherwise the steel will crystallise with slow cooling, will lose elasticity, and become what is ordinarily called "burned." Caron states that "burned" iron can restored by raising it to a white heat, and then placing it under the rapid action of a steam hammer. Chernoff also describes and explains the case of a "burned" ingot of steel, which he treated in the above manner and restored to its proper condition. Osborn states that steel has a remarkable property of remaining in a pasty condition through a considerable range of temperature below its melting point; and that bar-iron acquires a largely crystalline structure when exposed for a long time to heat considerably below fusion.

Professor Gore, in 1869, and subsequently Professor Barrett, in 1873, drew attention to certain anomalies that occurred in the expansion and contraction of iron wire: and in 1877 Professor Norris published the results of his experiments on the same subject, which appear to confirm Chernoff's theory in a remarkable manner. In cooling a strained iron wire from redness, it was found that the contraction due to cooling was, at a certain point and for a limited period, changed into an action of elongation. In good iron wire this irregularity could not be detected, but in hard wire and steel it was very apparent. The wire has to be raised to a very high temperature before the temporary elongation during cooling can be seen; and it does not take place if the wire is heated only just beyond the temperature at which it occurs. Professor Norris's researches have led him to the following conclusions:—(1) That in steel, and in iron containing free carbon, there is a contraction or shortening which is excited by heat, and which proceeds simultaneously with the dynamical expansion and masks its true amount. This is divisible into high and low temperature contraction. (2) That similarly there is a cooling expansion or crystallisation, which comes in during the dynamical contraction and masks its true amount. (3) That these effects, due to crystallisation and decrystallisation, are the causes of the so-called "kicks," or temporary contractions and expansions, which occur during the heating and cooling respectively of the steel. (4) That the low-temperature contraction and cooling expansion are due to decrystallisation and crystallisation, which occur during the acts of heating and cooling; while the "kicks" themselves are simply the thermal effects associated with these changes, and are proportionate to their extent. (5) That protracted annealing, *i.e.*, extremely slow cooling, brings about molecular separation of the carbon and iron. Steel in such a state contracts greatly when high temperatures are reached, producing the effects of contraction which are seen at the ends of the heating, and which are due to the condensation produced by the recombination of the carbon and iron. Steel in this state is less susceptible to cooling-expansion (or crystallisation), and therefore to low-temperature contraction on subsequent heating." It would seem that the "kicks" observed by Professor Norris probably occur somewhere in the region of Chernoff's temperatures *a* and *b*, where a change in the melocular structure of steel appears to take place according to his theory. At any rate it is plain that molecular changes of some kind do occur, and manifest themselves by altering the bulk of the metal.

It has already been stated that Müller has demonstrated the presence of hydrogen, nitrogen and carbonic oxide in the pores of Bessemer and Siemens-Martin steel. Edison, at the recent meeting of the American Association for the Advancement of Science at Saratoga, has extended the observations at Döbereiner, St. Clair-Deville, Troost, Faraday, and Graham; and has not only applied the facts ascertained to explain the destruction of refractory metals, such as platinum and iridium, under long-continued high temperatures, but has discovered the means of overcoming those defects, which have proved a serious hindrance to the extension of electric lighting. Edison noticed that the effect of incandescence on wires was to produce, all over their surface, innumerable fine cracks. When the incandescence was maintained for twenty minutes these fissures became so enlarged as to be visible to the naked eye; and, when still further continued for several hours, the cracks united and the wires fell to pieces. A number of experiments have led him to the conclusion that the cracking of the surface of the metal is due entirely to the occluded gases, imprisoned within its pores, which become expanded and are driven out under the action of heat. By heating spirals of platinum wire gradually, by means of a transmitted electric current of periodically increasing strength, and within an exhausted chamber, the gaseous substances contained within the metal were gradually withdrawn; and by allowing the metal, in the interval between each increase of temperature, to cool down *in vacuo*, a series of expirations from the surface took place, alternating with a closing up and welding together again of the minute fissures through which the gentle heating *in vacuo* had enabled the gases to escape. By continuing this simple operation it has been found possible to change completely the physical character of metals; increasing their hardness and density to an extraordinary degree, and raising their points of fusion so high that they are perfectly unaffected at temperatures at which most substances would be melted and even volatilised. A spiral or ordinary platinum at a white heat softens and loses its elastic and rigid character; but platinum, after having been treated in the manner above described, becomes as rigid as steel, and as homogeneous as glass; and retains these properties when glowing under the most intense incandescence. The metal so transformed cannot be annealed by any known process.

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[*] Mém. de la Soc. des Ing. Civ. 1852, p. 110, &c. Comptes Rendus xlvi. (18 8) p. 802 and li. (1860) p. 974.

[†] See Proceedings Inst. M. E., June and October, 1878, and April, 1879.

[‡] Proceedings Inst. M. E., April, 1879, Pl. 23, fig. 14.

[*] Report to Research Committees of the Institution of Mechanical Engineers.

It appears to the committee that the expulsion of the gases contained in the body of the metals may have the effect of bringing the ultimate atoms closer together, increasing thereby the force of their cohesion, and consequently resisting more strongly any rearrangement that would be necessary in annealing. It would appear also that the existence of gases in the pores of metals is an attribute of their normal states; and that the expulsion of the gases increases hardness and necessarily raises the melting point on account of the stronger cohesion of the atoms. May it not be that the sudden contraction in hardening steel has the effect of expelling occluded gases; that subsequent tempering, by raising the temperature, has the effect of permitting a fresh absorption; and that the iridescent colours which accompany tempering are due to the change of surface caused by the infiltration of gases? Another view is that the mere heating of steel to the proper temperature for hardening is sufficient to expel a portion of the gases, which are kept out by sudden cooling, and are slowly re-absorbed in tempering. Graham states that platinum at a low red heat will absorb four times its volume of hydrogen, and that palladium condenses more than 600 times its volume of hydrogen at a temperature below that of boiling water. May not steel therefore possess analogous properties with respect to some of the gases constituting the air? May it not absorb these more freely as the temperature of tempering rises, and so gradually become restored to its original softness?

### VI.—*Directions in which further Investigations appear to be needed.*

(1) To investigate whether Edison's theory can be applied to the explanation of the hardening and tempering of steel; and to ascertain by experiment whether absorption and expulsion of gases take place. (2) To determine by analysis whether any chemical difference exists between the outer and inner layers of a piece of hardened steel, which before hardening was of homogeneous structure. (3) To ascertain whether there is any connection between Chernoff's theory and Norris's observations on the contraction and expansion of wires.—Signed on behalf of the Committee, 5th Nov., 1879, W. Anderson, Chairman and Reporter.

### APPENDIX.

List of Works Consulted.—Percy, "Metallurgy of Iron and Steel"; Chernoff, "Remarks on the Manufacture of Steel and the mode of working it," 1868; Barba, "Etude sur l'emploi de l'acier dans les constructions," 1874; Camus, "L'art de tremper les fers et les aciers," 1846; Osborn, "Metallurgy of Iron and Steel," 1869; Jullien, "Théorie de la Trempe," 1865; Jullien, "Résumé de mes recherches sur l'aciération," 1868; Caron, "Recherches sur la composition chimique des aciers." (Mémoires des savants étrangers, publiés par l'Académie Royale de Belgique, 1865); Gruner, "Traité de Métallurgie," article viii., 1878; Various Specifications for the supply of Steel to the French Navy, 1879; Gore, "On a Momentary Molecular Change in Iron Wire" (Proceedings of the Royal Society No. 108, 1869); Norris, "On certain Molecular Changes which occur in Iron and Steel during the separate acts of Heating and Cooling" (Proceedings of the Royal Society No. 180, 1877); Baumhauer, "On Diamond" (Annalen der Physik und Chemie, neue Folge, vol. 1., p. 467, 1877); Overzier, "On the Flotation of Solid Iron in Fluid Iron" (Poggendorf's Annalen. 1870, vol. cxxix., p. 651); Akerman, "On Hardening Iron and Steel: its causes and effects," Iron and Steel Institute, 1879; Tyndall, "Heat as a Mode of Motion," 1870, on Fusing Points of Substances as affected by Pressure; Edison, "The Action of Heat on Metals *in vacuo*," American Association for the Advancement of Science, 1879 (*Nature*, Oct. 2nd, 1879). Proceedings of the Institution of Civil Engineers, as under:—Douglas Galton, on Chilled Iron Wheels (vol. liii., p. 35, 87); Siemens and Fernie, discussion on Fox's paper on Pennsylvania Railway (vol. xxxix., p. 100, 110); Hackney, on the Manufacture of Steel (vol. xlii., p. 1); Siemens and Riley, discussion on Price Williams's paper on Railways (vol. xlvi., p. 198, 203); Euverte, on the Effects of Phosphorus and Manganese upon the Mechanical Properties of Steel (vol. xlix., p. 360); Mannermann, Studies on the Cementation Steel Process (vol. lvi., p. 361); Müller, on the Gases enclosed in Iron and Steel (vol. lvi., p. 360); Boyd, "Experiments relative to Steel Boilers," Proc. Inst. Mech. E., 1878, p. 217. "Mechanics' Magazine," as under:—Tempering of Steel, rules by a "clever workman," 1855, p. 515; R. Burn, on Tempering in Oil (1857, p. 110); M. Gaudin, on Heating Iron with Boron, Phosphate of Iron and Peroxide of Manganese (1865, p. 389); Anonymous Article on Tempering (1867, p. 119); ditto (1870, p. 184); W. L. Austin, on "Hardening and Tempering," 1879 (M.S.)

# SCIENCE AND ART.

## PROCEEDINGS OF SOCIETIES.

### THE INSTITUTION OF CIVIL ENGINEERS.

At the meeting on Tuesday, the 20th of January, Mr. W. H. Barlow, F.R.S., President, in the chair, the first paper read was on "Fixed and Movable Weirs," by Mr. L. F. Vernon-Harcourt, M.A., M. Inst. C.E.

Weirs were employed for raising the water-level of a river for navigation, for irrigation, or for mills. A weir was placed across the secondary channel of a river, when the navigation channel was occupied by a lock; and it served for maintaining the water above at the proper level for navigation, the discharge of the river flowing over the weir. Weirs constructed on the Severn about forty years ago were placed obliquely across the stream to increase their length, and thus to ensure a greater discharge over them. Pointed and curved weirs had been often used for the same purpose, with the additional advantage of keeping the main current in a central channel. These weirs, which might be termed overfall weirs, were commonly formed of a bank of rubble stone protected on the face by pitching, and secured from undermining by sheet piles. Draw-door weirs had frequently to be provided in addition to overfall weirs, to give sufficient outlet for a river in time of flood. A draw-door weir consisted of a series of upright posts, placed at regular intervals across a portion of the stream, between which panels or doors slid into grooves, and were raised or lowered from a foot-bridge above. Teddington weir furnished a fine example of a composite overfall and draw-door weir placed very obliquely across the Thames. Small draw-door weirs, as well as overfalls, were generally constructed at water-mills, [for regulating the flow of the stream. Weirs, called anicuts, had been erected across several Indian rivers, to preserve and divert water for irrigation. Formerly they consisted of embankments of sand or loose stones, which held up the water in the dry season and were washed away in flood time. They were now generally made of dry rubble, concrete, or rubble stone set in cement, protected on the face by pitching or ashlar, with a flat slope on the downstream side. Sluices at the side served to discharge any excess of water and to remove silt. The Godavery anicut had a total length of 2½ miles, and the Dehree anicut was 2½ miles long. Some of the weirs in Northern India had piers in the central portion, with intervals between them, which were closed by planks sliding down grooves in the piers, or sometimes by gates turning on a horizontal axis on the floor-level. These open weirs were termed dams in India, and resembled draw-door weirs and M. Thénard's movable shutter weir. Dams cost less than anicuts, interfered less with the flow of the river, and prevented the accumulation of silt above the weir. A brief history and description followed of the various kinds of movable weirs erected on some rivers in France and Belgium. There were no instances, as far as the author was aware, of similar weirs in England; and very little information was given about them in the proceedings of the Institution, or in other English publications. Movable weirs were barriers placed across a river to keep up the water-level in dry seasons; and they were frequently employed for conducting the navigation intermittently by flushing. This consisted in producing a temporary artificial flood by the sudden opening of the weir, by which a convoy of boats, collected above the weir, were floated over the shallows below. In time of flood these weirs were entirely removed so as to present no obstruction to the flow. There were five different types of movable weirs:—(1) the Bear trap, (2) M. Poirée's frame or needle weir, (3) M. Chanoine's shutter weir, (4) M. Desfontaine's drum weir, and (5) M. Krantz's pontoon weir.

1.—*The Bear Trap.*—The first weir of this type was erected on the Lehigh River, Pennsylvania, in 1818, and had since been introduced into France at Laneuville-au-Pont on the Marne. It consisted of two gates turning on horizontal axes at the bottom and inclined to one another when raised, the upper gate resting on the top edge of the lower gate. When the weir was lowered, the up-stream gare late lay flat on the down-stream gate. The gates were raised by introducing water under them from the upper pool, and lowered by letting the water below them flow away into the lower pool, the sluice gate communicating with the upper pool having been shut.

2.—*Frame or Needle Weir.*—This system consisted of a series of wrought-iron frames, placed parallel to the current, turning on hinges fixed to the apron, and connected and secured when standing upright by movable horizontal iron bars. Wooden spars or needles, resting against the sill at the bottom and against the horizontal bars at the top, formed the dam which kept up the water. The frames were placed about 3½ feet apart, and carried a footway on the top, on which the weir-keeper stood to remove or replace the needles. When the river was in flood, the needles having been removed, the frames could be laid flat on the apron. The first needle weir was erected on the Yonne in 1834, and since then the system had been introduced on several rivers in France, and on the Meuse in Belgium. This system was not well suited for high weirs, on account of the great increase in weight of the needles. Accordingly at Notre-Dame-de-la Garonne the needles had been replaced by a sort of shutter, formed of a series of horizontal boards jointed together, which slid between the front part of the frames, and which could be rolled up when the weir was to be opened. M. Boulé had used a series of horizontal boards for the same purpose, which could be lifted successively by a crab on the foot bridge.

3.—*Movable Shutter Weir.*—This consisted of a gate or shutter, turning on a horizontal axis a little below half its height, supported on the top of a wrought-iron tressel hinged to the apron of the weir. When the weir was closed the tressel was upright, the shutter abutted at the bottom against a sill and was supported in that position by a wrought-iron prop hinged to the tressel, inclined at an angle of 45° and resting at the bottom in a cast-iron shoe, from which it could be released by a sideways pull produced by a bar with projections. When the prop was released it slid down the apron, and the tressel and shutter fell flat upon it. The weir was raised by pulling up the shutter to a horizontal position by a chain attached to its lower end, and when the tressel was upright and the prop in position the pressure of the water sufficed to close the shutter. The first of these weirs was erected at Conflans-sur-Seine in 1858; and several others had since been put up on the Seine, the Yonne, and the Marne.

4.—*Drum Weir.*—This was composed of two paddles able to make a quarter of a revolution round a horizontal axis between them. The upper paddle formed the weir gate, and was moved by water, let in from the upper pool into a recess below the sill, called the drum, acting upon the lower paddle, causing it to revolve. The weir was closed or opened according as the water was admitted into the drum on the upper or the lower side of the lower paddle. The first weir of this kind was erected at Damery, on the Marne, in 1857; and similar ones had been used at several overfall weirs on that river.

5.—*Pontoon Weir.*—The shutter closing the weir was hinged to a wrought-iron pontoon floating in a cast-iron conduit and hinged to the lower side of it, both pontoon and shutter revolving on horizontal axes. When the weir was open the pontoon lay flat in the conduit, with the shutter resting flat upon it. To close the weir, water was let into the conduit from a reservoir at a higher level. The pressure of the water raised the pontoon, which revolved on its axis at the lower end and raised the shutter. A weir of this construction had been commenced at Port-Villez on the Seine; but some experiments at Bougival indicating a difficulty in working it, this type of weir was abandoned at that place.

The Bear Trap weir was complicated and not suitable for high weirs. The Drum weir was only applicable for overfalls on account of the depth below the sill required for the drum. The Needle and Shutter weirs had been the most extensively adopted, and were the best types of movable weirs. The simplicity of the needle weir rendered it preferable for low weirs across rivers with continuous navigation and even flow; but the shutter weir was the most suitable for high weirs across rapid rivers, and where the navigation was conducted by flushing.

The neglect and silting up of rivers and the extension of subsoil drainage were the cause of the floods which so often occurred in river valleys. The existing river-channels being unable to carry off the flood waters, even in summer, must be enlarged. This could be done by raising banks at the sides, or by increasing the depth and width of the channel. The first plan, though cheaper in the first instance, had led, in the long run, to so many disasters, that the author was convinced that, except in districts like the Fens, where no fall was obtainable, the embanking of rivers beyond the tidal portion of their course was unadvisable. The alteration of existing weirs must form a part of any scheme for mitigating floods, and additional weirs would be needed if the river-bed was lowered, in order to keep up the water-level in summer for the sake of lands. Movable weirs, when lowered, presented no obstruction to the stream; they could be carried to greater depth than the ordinary type of fixed weirs; and they could be made self-acting. In conclusion, the author expressed the opinion that movable weirs, which had been successfully adopted in France for a long time, were worthy of the notice of English engineers.

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The second paper was on "Movable Dams in Indian Weirs," by Mr. R. B. Buckley, Assoc. M. Inst. C.E.

This paper commenced with a brief description of Indian weirs, and then proceeded to show the necessity for having portions of these weirs movable, so that the silt and deposits of different kinds might be swept away from the heads of the canals supplied from the rivers above the weirs. A description was given of the form of movable weir which had been adopted on the Mahanuddee and Cossye Rivers. The shutters were hinged to a horizontal axis on the floor of the sluice in two rows placed back to back. The upper ones folded up stream and the lower ones folded down stream. The back or down-stream shutters were about 18 inches higher than the front row. When the movable dam was open and the water flowing over it, the front or up-stream shutters where held by hooks to the floor, so that they could not rise. To close the sluices the hooks were released by a bar, which could be manipulated from the pier; the shutters were at the same time slightly lifted by the same bar, and when the stream got under them they were forced upright. Chains, which were attached to the front of the shutter, received the severe blow which was brought on them by the sudden raising of the shutter. The back shutters, as soon as the front ones had been lifted, were raised by hand from the back, and were retained in position by wrought-iron struts behind them. When all the back shutters were up, the lower ones were pushed down on to the floor and fastened with the hooks, and the movable dam was then ready to be opened at any moment. To open the movable dam, the struts of the back shutters were released from the cast-iron shoes in which they rested, by the action of a horizontal bar which lay on the floor. This bar caught the struts one after another, and it was moved by gearing on the pier, and released them; the shutter then fell and the waterway of the sluice was opened.

On the Sone weir the movable part was in three lengths—one at each end, and one at the centre of the weir. Each length consisted of twenty-two shutters, 20 feet 7 inches long by 9 feet 9 inches high. There were two shutters, the front and the back one, between stone piers; the front shutter was hinged horizontally at its heel to the floor. It folded forward—or up stream—into a nearly horizontal position on the floor. Each shutter had on its down-stream side six hydraulic brakes. These impeded the closing of the shutter, and prevented the shock which was so objectionable in the form of movable dam previously described. The brakes were simply formed of a pipe which was hinged to the shutter, and a strut hinged to the floor, the head of which was fitted with hydraulic packing, When the front shutter was lying horizontally the pipe became full of water from the river. In the pipe were three holes $\frac{3}{16}$ths inch in diameter, through which the water was expelled as the shutter rose. The back shutter was hinged by tension rods on its up-stream face. The rods were hinged at one end to the shutters a few inches below the centre of pressure of the water on the shutter when erect; the other extremities of the rods were hinged in the floor between the two shutters. The shutters, when the water was level with their crests, were on the point of overturning, as they were hinged slightly below their centre of pressure. When the water rose a little above their crests, they did overturn. Chains to prevent them doing so were fitted with let-go-gear. As a rule, the back shutters were kept up to retain the water, the front ones being fastened down on the floor. If a flood was expected, the chains of the back shutters were let go, and when the river had risen to a certain height, they opened of their own accord. To close the movable dam, the front shutters were one by one slightly raised by hooks worked by levers from the piers. The stream then impinged below the shutters, and forced them up into the vertical position. The hydraulic brakes decreased the velocity with which the shutter would ascend, and relieved the piers and masonry from shock. When the front shutters had been raised, the back ones were pulled up by hand, and the front ones were put back into their horisontal position on the floor. Some improvements in this form of weir were suggested. As the action of the movable dams of the Sone weir had not been found sufficiently powerful to keep a channel clear for navigation, a row of shutters, similar in principle to the back shutters, but only 2 feet 3 inches high, was to be placed all along the crest of the weirs, which were 2¼ miles long. The paper described briefly a system of double-tumbler shutters, which had been proposed by Mr. Fouracres, who introduced the system of the Sone weir, but which had not been as yet adopted in practice.

## MANCHESTER GEOLOGICAL SOCIETY.

THE ordinary meeting of the members of the above society was held on Tuesday, last week, at Manchester, Mr. E. W. Binny occupying the chair.

The Chairman said he was sorry he had not an opportunity of hearing the paper read at a previous meeting by Mr. Aitken on the discovery of ancient ironworks, but he might, perhaps, add that probably it was not generally known that before the introduction of coal for the smelting of iron there were furnaces in nearly every part of the country. In 1815 there were 800 furnaces in operation in various parts of the kingdom for smelting iron by charcoal, which was, he supposed, a much larger number than could now be found, and cinderhills were now to be met with all over the country.

Mr. W. Topping then read a paper on the method adopted in sinking through sand at the Barnferlong collieries, near Wigan, which was illustrated by a number of detailed plans and drawings. The depth of quicksand which had to be gone through was 25 yards, and was in some cases so fine as to be scarcely distinguishable from water. The operations, which were attended with great difficulty, were carried out by the improved method of sinking through sand with the end of cast-iron tubing, the total weight of which in one shaft was over 225 tons, and the pressure required to force it down was from 500 to 600 tons. The first consideration in sinking operations of this kind was to commence with the shaft wide enough, and in this case they commenced with a diameter of 27 feet, and secured a pit with a diameter of 16 feet 4 inches at a depth of 35 yards, until they came upon the rock upon which the foundation for the lining of the pit was based. Mr. Topping went into all the details of the operation, and it was decided to adjourn the discussion until after the paper had been printed and supplied to the members.

Mr. Plant laid before the members a collection of nodules from the Permian, found by Mr. Perrin at West Leigh, and promised a paper at the next meeting; and Professor Boyd Dawkins, F.R.S., and the Rev. J. M. Mills, F.G.S., described the results of further explorations of the caves of the Cresswell Crags, after which the proceedings closed.

## LIVERPOOL ENGINEERING SOCIETY.

THIS Society held its annual fortnightly meeting on Wednesday evening, the 28th January, at the Royal Institution, Colquitt Street. Mr. Alexander Ross, President in the chair, when a paper on "Feathering Propellers" was read by Mr. R. R. Bevis, jun.

The author commenced by stating that the objects obtained by the use of feathering propellers had long been a desirable one, and that patents had been obtained for them as far back as 1844. In pointing out the advantages to be gained by their use, special attention was directed to the fact that the pitch of the blades could be altered to suit the various requirements of a vessel, and examples were given to show how effective this had been in many cases. When in such vessels as gunboats and yachts it was desired to use their sails only, it was shown to be most important that the blades of the propeller should be placed in a fore and aft line, so as not to allow the screw to become a drag on the vessel, and cause the latter to steer badly. With the blades fore and aft the steering would not be interfered with, as they would form, as it were, a part of the dead wood of the ship, and nearly fill up the aperture, thus preventing the formation of cross currents about the rudder. Instances were given of the great increase of speed when sailing by such an arrangement, and it was remarked what great distances the yacht *Sunbeam*—fitted with a Bevis feathering propeller—had made under sail alone on a recent voyage. Mr. Bevis then described and explained a model of the Bevis Patent Screw Propeller, in which the blades are moved by gear within the boss, this gear being worked by a sliding-rod through a hollow propeller shaft. Propellers of this description have been working upwards of ten years, and, during that time had required no repair, but had had an occasional overhaul to make sure that all was right. They had been supplied to several foreign, and our own Governments, and for many yachts, and at the present time, half-a-dozen were being made for H.M. Navy. It was pointed out as the result of several experiments, that hollow shafts had greater strength than they were generally credited with.

**The Byron National Statue.**—The national statue about to be erected from the model of Mr. Richard Bett, sculptor, has been successfully cast by Messrs Cox and Sons, at their bronze foundry, Thames Ditton. The poet is represented seated upon a rock in an attitude of meditation, with his favourite dog by his side.

**Protection of Iron from Rust.**—Dr. Treumann, in a recent number of the *Deutsche Industrie Zeitung*, publishes a paper "On Means for protecting Iron from Rusting." He appears to have made a most careful examination of all the processes, including Dr. Barff's, which have been introduced. He arrives at the conclusion that no process is known at present which will keep iron effectively and durably from rust; that all protective compositions require careful supervision.

**International Agricultural Exhibition at Hamburg in 1882.**—A committee has been formed in Hamburg for the purpose of arranging for an International Agricultural Exhibition to be held in that city in 1882. The first and only exhibition of this kind held there was in 1863. In the new exhibition the main object will be to secure as large a show as possible of horses, cattle, sheep, and pigs of German as well as of foreign origin; but other kinds of agricultural produce and agricultural machinery are also to be included in the programme.

**Association of Foremen Engineers.**—At the ordinary monthly meeting of London Association of Foreman Engineers, to be held on Saturday the 7th inst., at Cannon Street Hotel (8 p.m.), Mr. A. T. Walmisley, C.E., will read a paper on "Thames Bridges—Old, New and Projected," and this sitting, as usual, will be a public one. The twenty-seventh anniversary festival is appointed for Saturday, March 20th, when the Right Hon. Sir Francis Wyatt Truscott will preside, and be supported by the Sheriffs of London and Middlesex, together with many other distinguished personages.

**The Manufacture of Diamonds.**—Addressing the Philosophical Society of Sheffield, on Tuesday evening, on the subject of the manufacture of precious stones, Mr. A. H. Allen, borough analyst, said that Dr. R. S. Marsden, a native of Sheffield, had recently been trying experiments in connection with the production of crystallised substances and he had succeeded in obtaining the crystalline form of a body which Mr. Allen thought might possibly be diamond. This result was obtained by an entirely new process, and there was every probability that the body thus procured was crystallised carbon (a diamond).

**Luminous Dials.**—A French company has been introducing clocks by which the hour "can be seen in the dark" into this country. Messrs. Thlee and Horne, of Aldermanbury, have patented a process for producing a "luminous paint," and a company for working this patent is being formed. The luminous paint is, virtually, a sulphide of calcium prepared by a special process. After a few minutes' exposure to light it will, if taken into a dark place, glow with a white lustre faintly tinted with violet. It must be remembered that the phosphorescent paint, whatever it may be, must be exposed for some time to sunlight before any phosphorescent light will be emitted by it in the dark.

**"The Graphic" Gallery.**—An exhibition will shortly open which, at a time when there is so much controversy on the subject of female beauty, promises to be of some interest. The proprietors of *The Graphic* have commissioned most of the leading artists of the day each to paint a head typifying his conception of Beauty. They have taken up the idea with great spirit, and the result is a number of admirably-painted heads, and doubtless there will be many discussions and differences of opinion as to which is the most beautiful. Among the artists who contribute are Sir Frederick Leighton, P.R.A.; Messrs. Alma Tadema, A.R.A.; E. Long, A.R.A.; P. H. Calderon, R.A.; G. D. Leslie, R.A.; J. J. Tissot; G. Storey, A.R.A.; Marcus Stone, A.R.A.; Philip Morris, A.R.A., and others. There will also be exhibited at the same time an important work, just finished, by Mr. J. E. Millais, R.A., called "Cherry Ripe." "*The Graphic*" Gallery, which is situated at No. 14, Grafton Street, will be opened to the public on Monday, the 16th of February, and the entire proceeds will be given to a Charitable Fund for Artists.

**Institute of Art.**—At the close, on Saturday, of the winter exhibition of this society for encouraging the production of art work, more especially by ladies, the prizes awarded to successful competitors were presented by the Hon. Mrs. Armytage. The exhibition, which comprised some very beautiful productions of the needle, the brush, and the chisel, was opened at the galleries, No. 9, Conduit-street, at the end of October last. There are at present about 400 members of the institute, and among those present on Saturday were Lady Emily Dundas, Charlotte Lady Fitzhardinge, Madame Ronniger and Miss Samuda. The nature of the exhibits will be sufficiently indicated by a list of the classes in which awards were made:—Oil painting, prize to Miss Sophia Beale; water-colour painting, to Mrs. Emily Jackson; painting on china, Miss Dunlop; lace-making, Miss Malinda Hoge; crewel work, Mrs. Elliot Scrivenor; and embroidery, Mrs. Percy Smith. On the 14th of this month the committee will be prepared to receive articles for the spring exhibition, which will be opened on the 1st of March.

**The Buenos Ayres Exhibition.**—Mr. John Hayes, of 27, Leadenhall Street, having received a great many applications for entries of miscellaneous exhibits, asks us to state that as the exhibition is essentially a South American one, and cosmopolitan only in matter of "machinery," therefore exhibits from countries outside South America can only be of "machinery," and that engineers or firms wishing to exhibit the latter can have full particulars as to the most suitable class of machinery to send out. On application exhibits may be entered up to the end of April next, the time for this being further postponed by the commissioners at Buenos Ayres. The plans of the exhibition are shortly expected. Exhibits from the United States will figure largely in the exhibition, and from the apparent apathy with which it is regarded on this side, it seems that British machinery will play a very unimportant part at Buenos Ayres unless the engineering firms of this country bestir themselves between this and the end of April. Special agents have been sent out from the United States for the exhibition alone.

**The Institution of Civil Engineers.**—At the meeton Tuesday, February 3rd, Mr. W. H. Barlow, F.R.S., President, in the chair, it was announced that the Council had recently transferred Mr. John Penn to the class of members, and had admitted Messrs. W. N. Blair, A. M. Brand, H. G. C. Dymoke, J. R. Fawkner, W. Liddle, W. Marriott, R. St. George Moore, W. Page, J. D. Smelt, and J. H. Turner, as students. The monthly ballot resulted in the election of J. Tyndall, F.R.S., as an honorary member; of Messrs. G. Anderson, South Indian Railway, Tanjore; J. C. Bothams, Engineer to the City of Salisbury; C. A. Brereton, Executive Engineer, Waterford, Dungarvan and Lismore Railway; T. W. Miles, Ex.-Engineer, P.W.D., India; S. A. Stewart, Ex.-Eng., P.W.D., India, and L. Wood, Past-President of the North of England Institute of Mining and Mechanical Engineers, as Members; of Messrs. A. W. H. Bellingham, Stud. Inst. C.E., Adelaide, S.A.; R. C. Brebner, Stud. Inst. C.E., Ramsay, Isle of Man; J. G. Chandler, Addlestone Linoleum Company; C. W. F. Farewell, Stud. Inst. C.E., Resident Engineer, North Somerset Railway; J. R. George, Wellington, N.Z.; C. H. Holme, Stud. Inst. C.E.. Assist. Eng., P.W.D., India; H. B. Hutchings, Stud. Inst. C.E., P.W.D., Madras; G. Jameson, Stud. Inst. C.E., Westminster; R. H. Julian, B.E., Cork; J. W. Logan, Market Harborough; E. R. Morris, Millwall Pier; W. W. Shanks, late Ex. Eng., P.W.D., India; C. L. Sim, Oudh and Rohilkund Railway, Lucknow; G. H. Sykes, M.A., Dublin; J. C. Vaudrey, Stud. Inst. C.E., Derby; and F. Walsh, Borough Engineer, Burnley, as Associate Members; and of Capt. S. Buckle, R.E., Colonial Engineer, Gibraltar; Messrs. R. Capper, General Superintendent of Swansea Harbour; C. Higgins, M.A., Temple; and J. O. Phillips, Chief Officer of the Chartered Gas Company, as Associates.

**Birkbeck Literary and Scientific Institution.**—The 56th anniversary meeting of this Institution, on Tuesday last, was marked by the ceremony of distributing prizes and certificates to students who have distinguished themselves. Lord Aberdare presided. Lord Aberdare, after presenting the awards to the successful students, reviewed, with some detail the progress of elementary and intermediate education in this country during the last sixty-five years. Referring to the work which this Institution was carrying on, he remarked that since its foundation some 70,000 students had entered its classes, and that at present there were over 3600 students on the books and no less than 1300 in daily attendance. Turning to the importance of the work undertaken by this and similar institutions, he dwelt upon the enormous responsibilities undertaken by the inhabitants of this small country—the mistress of regions extending over all but nine millions of square miles. This population of five-and-thirty millions had become arbiter of the destinies of little less than 300 millions of the population of the globe, and of these only some eight millions were self-governing. Such great responsibilities could only be worthily discharged by constantly training the citizens of this country in every species of knowledge, literary and scientific, that would tend to the growth and development of nations. A resolution expressing satisfaction at the progress made in the collection of a building-fund, and urging the claims of the Institution to be generously assisted by the friends of education was moved by Sir Charles Russell, V.C., M.P., and seconded by Mr. G. M. Morris, the honorary secretary. The Bishop of Exeter, in moving a vote of thanks to givers of prizes and to the honorary examiners, said that in his opinion the work of the elementary schools in this country would be very greatly improved if, in addition to the examination by Her Majesty's inspectors, a system of prizes was established and opportunities offered to those in the elementary schools who displayed something of genius to continue their education.

**Coal.**—On Saturday afternoon Professor T. Rupert Jones, F.R.S., concluded his course of three lectures on coal at the Royal Institution, Albemarle Street, Piccadilly, with a detailed account of the organic remains, or fossil plants and animals, found in coal and coal-measures, compared with those associated with other fossil fuels. He then took a comprehensive survey of the whole ground trodden throughout the course. Under one division of the subject he had pointed out that the different kinds of fossil fuel, from peat to anthracite, graduate in their composition from that of wood to that of nearly pure carbon. He had intimated that wherever and whenever large quantities of vegetable matter had been accumulated and covered up more rapidly than they had decayed, there seams of coal or of some other mineral fuel had been produced. The chemical changes which the trees and other plants had undergone after their accumulation—as fallen trunks, branches, leaves, and spares, with creeping stems, roots, and rootlets—in wet jungles and peaty swamps, had variously rearranged their constituent carbon, hydrogen, and oxygen. The results were:—(1) thin *laminæ* of hydro-carbonaceous coal, shining or dull, which alternate with thinner films of mineral charcoal (the product of sub-aerial rotting), where damp forest-growths prevailed; (2) layers of spares (white coal of Tasmania), or of leaves (fir needle coal of the Hanover wealden); (3) hydro-carbonaceous coals, more or less homogeneous in structure, where swamp-lakes and peat-bogs occupied the area of growth. Some coals might always have contained a relatively large proportion of touchwood and charcoal, and have been subjected to pressure, driving off the hydrogen with some of the carbon. In either case, anthracite coals had resulted, and natural distillation had produced various secondary hydro-carbons, such as albertite, bitumen, petroleum and naphtha. The history of the geological strata, from mountain limestone, through millstone-grit, to the coal-measures, their disturbances and present position, was thus brought within the reach of man's skill and labour. The lecturer concluded by pointing out that the study of the coal-measures was of great importance as a branch of natural history not to be ignored in the general scheme of a good education.

## MEETINGS FOR THE WEEK.

### MONDAY, February 9.

Royal College of Surgeons.—4 p.m. Professor W. K. Parker, on the Vertebrate Skeleton.

London Institution.—5 p.m. Rev. J. G. Wood, on Hibernation, Æsteration and Migration.

Royal Institute of British Architects.—8 p.m. Discussions on Architectural Competitions.

Royal Geographical Society.—8.30 p.m. The Earl of Northbrook, President. Sir Michael A. S. Biddulph, K.C.B., Afghanistan: the Eastern Border of Pishin and the Basin of the Loras.

Royal Academy.—8 p.m. Professor A. H. Church, on the Chemistry of Oil, Wax, Varnishes, &c.

London and Middlesex Archæological Association.—8 p.m.

*Society of Arts.—8 p.m. Cantor Lecture. Mr. Thomas Bolas, on the Manufacture of Indiarubber: Purification, Blocks, Sheets and Threads, Elastic Webbing. Other uses of Un-vulcanised Indiarubber.

### TUESDAY, February 10.

Royal Institution.—3 p.m. Professor E. A. Schäfer, on the Physiology of Muscle.

Anthropological Institute.—8 p.m. Dr. Emil Holub, on the Central South African Tribes, from the South Coast to the Zambesi.

Institution of Civil Engineers.—8 p.m. Mr. J. J. Webster, on Iron and Steel at Low Temperatures.

West London Scientific Association.—8 p.m.

Photographic Society.—8 p.m. Anniversary.

Gresham Hall, Lecture.—6 p.m. Professor Dallin, on Rhetoric.

### WEDNESDAY, February 11.

Royal Literary Fund.—3 p.m.

Royal College of Surgeons.—4 p.m. Professor Parker, on the Vertebrate Skeleton.

Graphic Society.—8 p.m.

Amateur Mechanical Society.—8 p.m.

Royal Microscopical Society.—8 p.m. Anniversary.

Hunterian Society.—7.30 p.m. Anniversary. 8 p.m. Oration.

Society of Arts.—8 p.m. Dr. Granville Cole, on a New Metallic Compound and its Application to Industrial and Artistic Purposes.

Society of Telegraphic Engineers.—8 p.m.

Royal Academy.—8 p.m. Professor Church, on the Chemistry of Oils, Varnishes, Wax, &c.

Gresham Hall, Lecture.—6 p.m. Professor Dallin, on Rhetoric.

### THURSDAY, February 12.

Royal Institution.—3 p.m. Professor Dewar, on Recent Chemical Progress.

London Institution.—7 p.m. The Rev. Professor Sayce, on the History of Writing.

Mathematical Society.—8 p.m.

Royal Society Club.—6.30 p.m.

Royal Society.—8.30 p.m.

Society for Encouragement of the Fine Arts.—8 p.m. Mr. George Bertic, on the Art Culture of the Assyrians.

Society of Arts.—8 p.m. Section of Applied Chemistry and Physics. Mr. Herbert Guthrie, on Gas Furnaces and Kilns for Burning Pottery.

Gresham Hall, Lecture.—6 p.m. Professor Dallin, on Rhetoric.

### FRIDAY, February 13.

Royal Institution.—8 p.m. Weekly Meeting. 9 p.m. Mr. W. H. Preece, on Wheatstone's Telegraphic Achievements.

Royal Astronomical Society.—3 p.m. Anniversary.

Quekett Microscopical Club.—8 p.m.

Royal College of Surgeons.—4 p.m. Professor Parker, on the Vertebrate Skeleton.

Royal Academy.—8 p.m. Professor Church, on the Chemistry of Canvas, Wood, &c.

Gresham Hall, Lecture.—6 p.m. Professor Dallin, on Rhetoric.

### SATURDAY, February 14.

Royal Institution.—3 p.m. Professor Ernst Pauer, on Sebastian Bach, with Illustrations.

Physical Society.—3 p.m. Anniversary.

Working Men's College.—8 p.m. Professor Tyndall.

## METALLURGY AND MINING.

### THE PROGRESS OF HEMATITE.

THE great improvement which during the past six months has taken place in all departments of the iron trade has been more observable in the hematite districts than in any other, and it is a noteworthy fact that values have advanced since last August upwards of 200 per cent., prices of best hematite being 45s. per ton then, against 140s. per ton this week. The change from bad trade to good trade was so speedy and so unexpected that sellers were suddenly surrounded with buyers who offered a few shillings advance on old rates, and bought very large quantities of metal; so that, when it became evident that the improvement in the market was more of a permanent than of a temporary character, sellers had largely disposed of their stocks, and had also entered into contracts at low prices for the delivery of pig-iron during last year and also during this year. They, in fact, entered into such large contracts for delivery forward, that now, when the extraordinary price of 140s. is offered, makers are only enabled to sell on terms of delivery extending over six, nine and twelve months, and even longer periods than this in some instances. The trade being done at present is of a speculative character to some extent, and it is a question whether the iron trade will continue to improve, or even to maintain its present position, and whether good and satisfactory relations will continue between buyers and sellers. The market is undoubtedly in an unhealthful state, although there are evidences all round of the consolidation of the improvement in demand which has sprung up for all qualities of metal; but any one looking back to the position of the trade at Midsummer last year will be free to admit that the change has been too sudden to last long, and that so soon as the American demand is satisfied the market must come down to something like a position on which a basis of commercial confidence can be formed. There is a probability, however, that prices have not seen the highest point, but that the extreme prices of 1872 and 1873 will be reached before the spring season sets in. The fact is that as sellers have sold so largely forward, and as buyers are pressing more and more for deliveries, prices continue every week to creep up to a higher figure. There is something, however, more than ordinarily peculiar in the present position of the hematite market. The recent revival has, in fact, demonstrated the great probability in times of good trade of a dearth and scarcity of hematite pig-iron. The advance of the steel age has been watched with considerable interest for a long time past, and now when an improved demand exists for all qualities of pig-iron it is observable there is a much greater drain than usual on hematite districts. The reason is not far to seek. This is the only class of metal from which steel can be made, with facility and economy, pending, of course, the practical result of the Thomas and Gilchrist process for purifying the Cleveland iron for steel purposes. There can be no doubt that with steel at its present value, verging, as it does on £10 per ton for best steel rails, the makers of Cleveland will find a sufficient margin of profit in making steel from native ironstone, even with the expense attendant on the process of eliminating the phosphorus. In Furness and Cumberland there are enormous deposits of unworked iron ore, and frequently new finds are made which display the existence of beds of metal in neighbourhoods where previously the existence of ore was not known. The percentage of metallic iron in the West Coast ores varies from 50 to 70 per cent., so that in smelting operations not only a high percentage of metal is obtained, but, comparatively speaking, but a small amount of slag has to be dealt with. The smelting of ore is therefore attended with satisfactory results as to the tonnage of output. The furnaces throughout the district are tapped four times a day, and they produce an average of 500 tons of metal per week. There are on every hand indications of speculation and enterprise on the part of manufacturers in the direction of increasing their powers of production by lighting furnaces which have been idle for a long time, and by building new furnaces. New works have been commenced and old establishments long standing idle are being put in work again. It is evident to most people that even in moderately satisfactory periods of trade there will be a considerable demand for hematite pig-iron as the metal from which steel—the great requirement of the future—can be most readily made, and the article from which a most reliable steel can be produced. It is noteworthy while on the one hand makers of steel rails require large parcels of Bessemer iron, producers of Siemens-Martin steel consume very large parcels of No. 3 hematite forge, so that both the qualities of hematite produced in Lancashire and Cumberland are in great request by makers of all classes of steel; and as steel is to be the metal of the future, there is a very hopeful look out for a district like Furness and Cumberland, which is so fortunately situated by reason of its large hematite deposits. But these deposits are not yielding a sufficient quantity of raw material to meet the demand now experienced, and as a consequence large cargoes of Spanish and Irish ores are being imported. The brown hematites of Antrim are within easy reach of the Furness and Cumberland districts, and some very large contracts representing probably in the aggregate upwards of 100,000 tons have to be delivered this year to West Coast makers. On the other hand, every effort is being made to increase the output of iron ore from the Furness and Cumberland mines, and as prices have now gone up to 35s. per ton it is evident that every exertion will be put forth to bring to the surface as much ore as possible. With the increased production of pig-iron, however, it is certain that not only will a large tonnage of native, but of foreign ores will be required. The great demand for hematites consequent on the development of the steel trade will represent a very brisk trade in hematites in the future, and it is obvious as the steel age advances—and indications of a very considerable progress in this direction are already presenting themselves in a most marked manner—the West Coast must of necessity participate to a large extent in the improved state of things, inasmuch as the most valuable ores, and at the same time the most suitable ones for steel production exist within Furness and Cumberland in almost inexhaustible quantities.

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ANTHRACITE IN CHINA.—It is stated that a valuable bed of anthracite has been prospected at Ching-mên-chow, near Ichang on the upper Yangtszikiang, and that it is already being worked. The coal district is said to extend 75 square miles, and to contain ten beds of coal, one of which, at Wo-tze-kow, is estimated to contain 1,200,000 tons, and lying only 100 feet below the surface.

MINE MANAGERS' CERTIFICATES.—The following gentlemen have successfully passed thier examination at Wolverhampton, and will receive certificates from the Secretary of State within a few days:—Mr. G. Turner, Dudley; Mr. R. S. Williamson, Camrock and Rugeley Collieries; Mr. P. Mr. Cherler, Blackwell Colliery, Alfreton; Mr. J. A. Fullwood, Gornal; Mr. R. H. Ward, Willenhall; Mr. J. Dudson, jun., Bentley; and Mr. A. N. Walker, Tettenhall.

CLEVELAND IRONMASTERS' REPORT.—The official statistics of the Cleveland iron trade for the month of January were issued on Wednesday. They show that the make of iron in the district has been increased 15,498 tons during the month, the output being 189,232 tons. That is higher than for many years past. There are now 99 furnaces in blast, as compared with 92 in January, 1879, and 76 in August last. There is a decrease of 16,655 tons in makers' stocks notwithstanding this largely increased make; but an increase of 8553 tons in warrant stores, so that the net decrease amounts to 8102 tons. The total stocks now amount to 274,684 tons, of which only 79,634 tons are in makers' hands. The shipments of iron to foreign parts show an increase of 15,123 tons as compared with January, 1879, and to ports on British coast an increase of 24,067 tons.

SOUTH STAFFORDSHIRE MINES DRAINAGE.—On Wednesday, at the meeting of the South Staffordshire Mines Drainage Commissioners, Mr. Walter Williams presiding, it was announced that all the money required on the Tipton loan of £40,000 had been borrowed and the debts paid. Authority was given to borrow £10,000 for surface drainage works. By the spending of £2000 or £3000 out of that money on the Bilston and Wednesbury brooks, it was stated there would be a saving of £1000 per year in pumping expenses alone. The chairman was also authorised to borrow £2000 to discharge some Kingswinford district debts. The award of the arbitrators for altering the boundaries of the Bilston and Tipton districts was received. By it the arbitrators recommend the annexation of the greater portion of the Bilston district on the Tipton side to the Tipton district, which receives so much water from the Bilston mines. The question will be considered a month hence, and will require the sanction of four-fifths of the Commissioners.

SOUTH STAFFORDSHIRE INSTITUTE OF MINING ENGINEERS.—At the thirteenth annual meeting of the South Staffordshire and East Worcestershire Institute of Mining Engineers, held at the new Mining Museum, Dudley, Mr. W. J. Haywood was elected president for the ensuing year, Mr. T. Brettell vice president, Mr. R. Latham treasurer and Mr. A. Smith, C.E., secretary. At the close of the president's inaugural address, Mr. A. H. W. Radcliffe, telegraph engineer, read a paper on the Edison loud-speaking telephone, and Mr. T. Paxton, F.S.S., a paper on "Colliery Accidents and their Prevention." He said the principal fatalities were due to the falls of roof and explosion. Something might be done by the introduction of lights without heat in mines, and he had a cardboard on which was imprisoned daylight. He had taken the board into a cellar and there read a newspaper. He believed the preparation would soon light up parts of mines where it was dangerous to use any flame. Mr. Parton then showed the cardboard, which was covered with carbonate and phosphorus of lime. The president moved a vote of thanks to the readers of papers and to the exhibitors of inventions, and this was carried unanimously.

ACCIDENTS IN MINES.—The second conference of authorities of permanent relief societies, and others interested in organisations dealing with distress caused by mining accidents, was held in the end of last week, in the Manchester Town Hall. Lord Lindsay presided, and there was a large attendance of gentlemen interested in the movement, representatives of all the permanent relief societies in the kingdom being present. The Chairman said the object of the conference was to bring together the officials and representatives of the permanent relief societies already established in the country for the discussion of subjects of mutual interest, and to associate with them others who had at heart the alleviation of distress caused by mining accidents, with the hope of extending the beneficent operations of the existing societies and forming other societies. According to the last returns of Her Majesty's inspectors, 382,979 men were employed underground. The permanent relief societies had enrolled 113,645 members, and the aggregate available balance was £106,530. The societies were providing for 689 widows and 1429 children, all, or nearly all, of whom would have been dependent on public charity had it not been for the existence of such societies. In addition to this, they had given assistance to 21,572 men during temporary disablement. It was noteworthy that the vast majority of the widows and children belonged to men who were not killed in large explosions, involving great loss of life, but to men who met their fate singly, by falls of roofs and like casualties. He trusted that the result of their deliberations would be to bring the existing societies into closer union, by means of a central organisation or committees, whose special objects should be to endeavour to extend their principles, and especially to give attention to the large balances of those funds which had from time to time been raised to meet disasters such as the Oaks, Hartley, Haydock, Blantyre, Abercarne, and others—balances which, he understood, amount to at least £100,000. Papers were read by the secretary and others on questions relating to permanent relief societies.

## SANITARY ENGINEERING, GAS AND WATER.

THE BIRMINGHAM WATER SUPPLY.—The Water Committee of the Corporation of Birmingham have received from Mr. Gray, their engineer, and Mr. W. Fowler, reports of their survey of the Terne Valley district, and of the watersheds of the several streams supplying the reservoirs and Wilton Plants' Brook and Whitacre, and have thereupon recommended the Council that they should be empowered to take such proceedings at law or otherwise as they may consider necessary for restraining and preventing the pollution of the river Terne or other streams from which the water supply to the borough is obtainable. They also propose to cover the reservoir at Monument Lane and to provide additional pumping power at Aston, at a cost of £17,000. The income arising from the supply of water to the borough for the past year is reported as £114,132, the gross profit as £77,967, and the surplus profit as £10,702.

THE GOVERNMENT AND THE METROPOLITAN WATER COMPANIES.—It is reported that the negotiations which have taken place between the Government and the Directors of the London Water Companies are founded on a capitalisation of the dividends, estimated with a due regard to all contingencies. Where the full statutory dividend is not at present being paid, the probability of an increase is to be allowed for. The terms have now been settled with all the companies, the Directors of the Lambeth Company being the last to come to an agreement. The machinery and works of the various companies are to undergo inspection, with a view to ascertain what amount of outlay, if any, is necessary to render them efficient. The inspection has already been completed in the case of the Chelsea Company, and the works of the Lambeth Company are now being examined. The financial scheme consists in the creation of Water Stock, and it is understood that the local rates of the metropolis will be made the guarantee for the payment of the dividends. The nature of the Trust or Commission to which the undertakings will be transferred is not yet definitely settled.

## RAILWAYS & TRAMWAYS.

THE LONDON TRAMWAYS COMPANY AND THEIR LATE MANAGER.—In the Exchequer Division on Monday, before the Lord Chief Baron and a special jury, the hearing of the case of "Jacques *v.* The London Tramways Company" was brought to a conclusion. This action was brought by a late manager of the defendants to recover compensation for injuries resulting from an alleged wrongful dismissal from their service. This was the eleventh day of the trial. The jury, after about twenty minutes' consideration, gave a verdict for the plaintiff, with £1000 damages.

PROPOSED RECONSTRUCTION OF THE TAY BRIDGE.—Formal notice has been given by the North British Railway Company of their intention to apply to Parliament for leave to introduce a Bill authorising the company to restore and improve the communication by railway over the River Tay. The notice is framed with the view to provide for the lowering and the doubling of the present bridge. It is proposed

—first, that a new bridge shall be constructed parallel, or nearly so, to the existing bridge, and braced thereto; second, that the present bridge shall be restored, with such alterations as may be deemed expedient—including, if thought proper, a reduction in the height of the whole or any part of it; third, that some of the existing spans may be contracted, and additional piers inserted; and fourth, that, in view of the reduced height, a corresponding alteration shall be made in the levels on the Fife side of the river. Provision is also to be made for regulating the passage of ships or vessels under the bridge, the idea being to leave one or two wide spans, or to limit the navigation to certain states of the tide, and preventing traffic over the bridge, pointing to the power of suspending it when, from any cause of wind, weather, or accident, it might be attended with danger. Commenting on the proposals for reconstruction, the *Dundee Advertiser* says these are chief structural indications; and, of course, they assume that, in the opinion of experts, what remains of the present bridge is, in design and workmanship, of such strength, stability, and durability as will justify its being retained as an integral part of the future bridge, which, we regret to hear, is likely to be contested in the course of the Government Inquiry. Should any of the present piers, or any parts of that superstructure, be condemned, that would not only involve considerably more expense, but suggest whether an entirely new double-line bridge should not be built. It is quite possible that the cost of repairing and strengthening the old bridge would be as great, and the result less satisfactory, than that of building a new low-level bridge.

## ELECTRICITY, TELEGRAPHY

MR. GRAHAM BELL.—The committee appointed by the French Minister of Public Instruction has awarded the Prix de Volta—50,000 fr.—to Graham Bell.—*Nature*.

THE FRENCH-AMERICAN CABLE.—The new French cable for America has been placed at the disposal of the public for correspondence. It goes direct from Brest to St. Pierre, and from St. Pierre to Massachusetts, where it is connected with the American Telegraph Union. A new cable will be laid from Brest to Penzance by the *Faraday* steamer, in the beginning of February, and afterwards from Penzance to St. Pierre. The second cable will be used for English telegrams.

THE PACIFIC CABLES.—It is now announced that the duplicate Australian cable has been completed, and is open for traffic. The new cable takes a somewhat different route to the original. The old cable from Singapore landed at Batavia, and the messages were sent over the Dutch Government lines to Banjoewangie, at the furthest extremity of Java, where the Australian section of the cable commences. By the new arrangement the Singapore section is taken direct to Banjoewangie, thereby avoiding the Java land lines, which will effect a great saving of time and tend to greater accuracy, as the messages will pass entirely through English hands.

NEW ELECTRIC CANDLE.—A French inventor, M. Perruche, has presented a new description of electric candle to the Paris Academy of Science. The candle consists of three carbons, two being cylindrical and 0·004 metre in diameter, and applied to each other; the third of square section, 0·005 metre inside, and placed in the angle formed by the first two. The cylinders are in pivoted brass holders between brass plates brought together by a spring. The holder of the square carbon is also capable of oscillation, and the carbon is held by a spring in contact with the other while no circuit passes, but, when the current begins, takes its separate position. It is regulated by an iron lever and electro-magnet in circuit.—*Electrician*.

THE POST OFFICE AND THE TELEPHONE.—With reference to the actions which were recently entered against the Telephone Company for alleged infringements of the Postal Telegraph's monopoly, the *Western Morning News* is enabled to state that an arrangement has been entered into between the Post Office and Bell's Telephone Company by which not only proceedings against the company will be abandoned, but the Postmaster-General undertakes to give every facility for the extension of telephone communications. The Telephone Company will pay a royalty to the Post Office, and may use the post offices and staffs under certain conditions for their work. Thus telephone wires may be run from a post-office to the town offices or country residences of gentlemen, and telegrams arriving at post-offices for them may immediately be communicated by telephone, thus saving time. To country gentlemen whose residences are distant from the nearest telegraph offices this accommodation will be invaluable. Telephone extension is progressing rapidly. One firm, whose offices are in London and Manchester, are laying a wire for telephones between their two establishments.

AN ELECTRIC LOG.—The well-known Massey's log is far from being a perfect instrument; one disadvantage is, that its counter being under water, the velocity at a given moment cannot be determined, and if there is a stoppage, one's ignorance of the point at which it occurred may render the indications rather useless. It has often been proposed to use electricity to transmit log-indications, as this would obviate the inconveniences just noted. An electric log, devised by M. Fleuriais, has been fully tested, with satisfactory results, on board the French frigate *La Magicienne*, in a recent long cruise. From a description of it in *La Nature* we gather that it is partly based on the principle of Robinson's cup-anemometer. A four-armed cross-piece, with cups at the ends of the arms all directed similarly in relation to the arms, is supported on a vertical axis so as to rotate in being pulled through the water, and proportionally to the rate at which this is done. The "mill" is of bronze, but to diminish friction the axis is supported in small blocks of guaiacum, which are at the ends of the arms of a bronze fork, presenting little resistance to the water. This fork is attached, through a short chain, to the log-rope, one strand of which is removed to make a place for the electric cable (a Menier military cable, with seven wires). The wire of the cable passes from the negative pole of a battery on board ship to the log, while the "earth wire" passes from the positive pole into an electric bell (without trembler); then, by a contact-breaker, on to a metallic bar communicating with the ship's sheathing. The rotating axis of the log (which has a double cylinder of wood and copper on it) has the slight resistance of a very elastic copper slip to overcome, and the arrangement is such that the bell gives one stroke for each turn. A sand-glass is also used. To determine the ship's velocity at a given moment (1) the circuit is closed; (2) the sand-glass is turned at one stroke of the bell, while one counts nothing, one, two, three, four, &c.; (3) the number is noted at which the sand-glass stops; and if, *e.g.*, this is 75, the velocity sought is 7 knots 5. Several of M. Fleuriais's logs are now used in ships of the French Navy.

## NAVAL ARCHITECTURE.

THE SUEZ CANAL.—A telegram from Lloyd's agent at Port Said, dated 31st January, 7 p.m., reports that the canal is again open for traffic.

THE AJAX.—The dockyard authorities at Pembroke have reported that the iron armour-plate turretship *Ajax* will be ready for launching on the 10th proximo, and the Admiralty have given orders for her to be launched on that date. The *Ajax* is a vessel of 8492 tons displacement and 6000 indicated horse-power, and the cost of her hull and engines will be £480,000, her engines alone, which are by Penn, costing nearly £100,000. The thickness of her armour at the water-line is 18 inches, and she will carry four 38-ton guns in her turrets.

DISASTERS AT SEA.—There were 24 British and foreign wrecks reported during the last week, making a total of 123 for the present year, or a decrease of 105 as compared with the corresponding period of last year. The approximate value of property lost was £360,000, including British, £290,0000. The *Bureau Veritas* has just published the following statistics of maritime disasters reported during the month of December, 1879, concerning all flags:—Sailing vessels reported lost—44 English, 16 American, 16 Norwegian, 14 French, 12 German, 9 Italian, 8 Austrian, 7 Dutch, 6 Greek, 6 Swedish, 3 Spanish, 2 Russian, 1 Danish, 5 of which the nationality is unknown; total, 149. In this number are included 4 vessels reported missing. Steamers reported lost—15 English, 2 Spanish, 2 French, 2 Dutch; total, 21. In this number are included two steamers reported missing.

NEW TYPE OF TORPEDO BOATS.—The torpedo-boats used in the English Navy are of two kinds—those of the *Lightning* class, measuring 84 feet in length and 100 feet 10 inches in beam; and those of the second-class, 60 feet long by 7 feet 6 inches broad. It has, however, been found from experience that first-class torpedo craft of the dimensions hitherto constructed are not sufficiently seaworthy to go out in any weather, and many Governments are, in consequence, adopting a larger size. Messrs. Yarrow and Company, of Poplar, are at the present time engaged in building several of the new type of torpedo-boats for various Governments, including those of Russia and the Argentine Republic. They are 100 feet in length by 12½ beam, and are intended to be capable of going to sea under all conditions of weather unattended by other vessels. Their fuel-carrying capacity will be sufficient for a run of 1000 miles. They are also built much stronger and heavier than has been hitherto the practice, and are expected to realise a speed of 19 knots.

MR. PLIMSOLL, M.P., ON THE LOSS OF GRAIN-LADEN VESSELS.—Mr. Plimsoll, in addressing his constituents at Derby, on Monday evening, drew attention to the grievous sacrifice of life and property during the past winter from the loss of grain-laden vessels. These losses, he said, are the more deplorable, since they nearly all arise from the shifting of the cargo, which, it is everywhere admitted, can be effectually guarded against, and that at the most trifling expense. These losses, are at once preventible, needless, and wicked. Since his return home he had ascertained that no less than thirteen grain-laden steamships were lost in the year 1879, chiefly in the last four months of the year, six of them so utterly that they have never been either seen or heard of from the day they sailed—The *Bernina*, the *Joseph Pease*, the *Surbiton*, the *Telford*, the *Homer*, and the *Zanzibar*. The men who perished in these vessels were, 20, 26, 22, 22, 30, and 35 respectively. The average tonnage of these vessels was 1804 tons each, and they carried an average of 99,000 quarters each. Besides these six there were five—the *Bayard*, the *Capella*, the *Emblehope*, the *Heimdall* and the *Tiara*—other grain-steamers lost, but in these cases only five lives were lost, the crews having been saved by other vessels in an unusual large number of cases last year. The entire eleven were lost as to ship and cargo, as were also two others, the *Commonwealth* and the *Trident*; but in these last two ships the one was a wreck and the other foundered after collision; these two, therefore, had nothing to do with the loading. The total number of grain-laden vessels, including steamers lost since Jan. 1. 1875, to December, 1879, was 60, an annual average of twelve. With this great, deplorable, and preventible loss of life and property he should ask Parliament to deal in the ensuing session. The hon. gentleman then urged that great reform was needed in the Merchant Shipping Acts, maintaining that the present arrangements as to load-line are illusory, and that there ought to be a compulsory survey and repair of disclassed vessels, while more strict regulations were required as to deck cargoes.

THE HANDEL FESTIVAL.—The great Handel festival which will be held at the Crystal Palace this summer, under the joint auspices of the Crystal Palace Company and the Sacred Harmonic Society, has been fixed for Friday, June 18th, Monday, June 21st, Wednesday, June 23rd, and Friday, June 25th.

THE TIN TRADE.—The Cornish smelters on Tuesday reduced the tin standard by £3 per ton. The standards now are; Superior common, 95s.; superior fine, 96s. per cwt. Owing to the reduction the share market has been considerably weaker, shares generally being offered at lower quotations. It is believed, however, that there will be an improvement before the end of the month.

## TO READERS AND CORRESPONDENTS.

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## CORRESPONDENCE.

### THE 38-TON GUN.

*To the Editor of* IRON.

SIR,—In your last issue I see a letter from Sir William Palliser, on the subject of the bursting of the *Thunderer's* 38-ton gun. There is one view in his theory (as set forth in the letter to which I allude) to which I would draw your attention, namely: Sir William Palliser states that the wad in front of the projectile must have assumed a cupped form or shape in consequence of the action or force of the rammer in sending home the shot. Now, let us analyse this point of the wad having been cupped: let any one place an ordinary saucer on a flat plane, now let the person interested observe the results of an ordinary hard ball striking the saucer, that is, when the ball is propelled along the plane on which the saucer is resting. Will not the force of the blow push or drive the saucer along the planes? Of course it will, and for the simple reason that the sides of the saucer though curved still offer a certain surface or plane of resistance. If, instead of a solid body like a boxwood ball, a strong blast of air is used, the result is just the same. Let the saucer be placed in a suitable tube and the results are just the same, for the curved sides of the saucer will always offer a certain plane or surface of resistance to the passage of either a solid or fluid body. It only remains to apply this mode of reasoning to Sir William Palliser's theory to see what a gross error he has fallen into. Had Sir William only stated that the wad retained its flat form, he would have had some show of reasoning on his side, for in that case the plane of resistance formed by the mere thickness of the wad—¾ of an inch—would have been scarcely sufficient for the powder-gases to act on so as to blow the wad out before the projectile. But when he states the wad was cupped, he at once adds an immense amount of surface for the powder-gases to act on, and as a result drive the wad out before the shot. Nor is this all; but the shape of the wad (when cupped) would have a great tendency to prevent its getting under the shot, for the raised sides would still interfere with such a result. And last, though perhaps least, were the wad cupped it might, in consequence of the great force applied and its resulting shape, have more or less stuck on the point of the shot. In fact the moment the cupped theory is admitted down goes the wedging. Trusting you will find space for this letter,—I am, &c.,

February 3, 1880. T. E. P.

## NOTICES OF BOOKS.

*Illustrated Biographies of the Great Artists.* Hogarth, by ARTHUR DOBSON. Sir Peter Paul Rubens, by C. W. KETT, M.A. London: Sampson Low and Co. 1880.

THE taste for art is happily extending among the masses of Englishmen, and the policy of encouraging and directing it as an element of technical improvement is becoming more and more accepted. As a help to the intelligent appreciation of the great painters, nothing could have been better devised than the present series, and the plan has been well and ably carried out. The authors of the two volumes under notice are evidently specially versed in the works of the painters whose memoirs they have written and whose works they have criticised and expounded. In each case there is annexed a bibliography of the principal books relating to the artist and his works, as a guide to readers who may wish to extend their researches beyond the outlines supplied by the authors. And portraits and numerous and well-executed engravings of famous or characteristic paintings are given. Those of Rubens are upon wood, and include the celebrated Chapeau de Poil, now in the National Gallery; the illustrations of Hogarth are photographic reproductions of special excellence.

*The Stars and the Earth; or, Thoughts upon Space, Time and Eternity.* With notes by RICHARD A. PROCTOR, B.A. Thirteenth thousand. London: Baillière, Tindal and Cox. 1880.

THIS is a reprint of a remarkable pamphlet, which has been out of print several years, and is now re-issued with notes by Mr. Proctor, bringing the science in it up to the present time. Its leading idea may be shortly stated from the work itself. Supposing an observer with infinite powers of vision in a star of the twelfth magnitude, the rays of light which commenced to undulate from then see the world, and all that was transacting upon it at the time, and passing swiftly forwards in the direction of the this earth at some period in the life of Abraham would just have reached the point at which the obsever stands; he would earth, its whole history would be transacted before his eyes from that time down to the time at which he reached us. In that way the anonymous author considers that a hitherto unknown clearness and insight can be given to our ideas of the omniscience, omnipresence, and eternity of God. The idea is carried still farther, and whatever other value it may have it is at least novel and original.

## NEW BOOKS.

Acoustics, Light and Heat. By T. W. Piper. 8vo. Philip.
Aid to Survey-practice, with Tables, &c. By L. D. Jackson. 8vo. Lockwood and Co.
Book (A) on Building. By Sir E. Beckett. 8vo. Lockwood and Co.
Chapters from the Physical History of the Earth: an Introduction to Geology and Palæontology. By A. Nicols. 8vo. Paine and Co.
Church Restoration. By Sir E. Beckett. 8vo. Lockwood and Co.
Construction (The) of Large Tunnel Shafts. By J. H. W. Buck. 8vo. Lockwood and Co.
Engineer's, Mining Surveyor's, and Contractor's Field Book. By W. D. Haskoll. Fourth Edition. 8vo. Lockwood and Co.
Field Naturalists' Handbook. By J. G. Wood and Theodore Wood. 8vo. Cassell.
History (A) of the British Marine Polyzoa. By T. Hincks. Two vols. 8vo. Van Voorst.
Influence (The) of Joy upon the Workman and his Work. By H. B. Hewitson. 4to. Sonnenschein.
Needlework. By E. Glaister. (Art at Home. Series I.) 8vo. Macmillan and Co.
Our Future Highway. By Comr. V. L. Cameron. Two vols. 8vo. Macmillan and Co.
Primeval Man. By the Duke of Argyll. New edition, 8vo. Strahan and Co.
Science and Scepticism. By S. M. Lanigan. 8vo. Simpkin and Co.
Story (The) of Earth and Man. By J. W. Dawson. Sixth Edition, 8vo. Hodder.
Woodworking Machinery: its Rise, Progress and Construction. By M. P. Bale. 8vo. Lockwood and Co.

## BOOKS RECEIVED.

Traverse Tables: for the use of Surveyors and Engineers. By R. L. Gurden. London: C. Griffin and Co.
The Great Artists—Leonardo da Vinci. By J. P. Richter. London: Sampson Low.
The Great Artists—Figure Painters of Holland. By Lord R. Gower. London: Sampson Low and Co.

## OBITUARY.

*Nature* announces the death of M. Walferdan, the inventor of the minimum thermometer, at Paris, at the end of January, at the age of 85, after a protracted illness of many years' duration. He was one of the members of the Constituent Assembly of 1848. Since that time he devoted all his leisure to scientific and artistic pursuits. He collected almost every picture drawn by Fragonard, one of the most celebrated French artists of the end of the 18th century. He sold his gallery to an English nobleman about twenty years ago, on condition that he should be appointed during his lifetime keeper of the gallery, with a salary of £500 a year, and that the gallery should be exhibited at his own rooms. This precious collection will shortly come to England.

BENJAMIN FISH, of Trenton, New Jersey, has rounded up ninety-four years of a remarkable existence. He lent Commodore Vanderbilt $1000 when that gentleman first started out in his career; brought down the first anthracite coal that descended the Delaware in 1823; managed the old stage line and steamboat company between New York and Philadelphia, fifty-five years ago; was one of the first directors of the Camden and Amboy Railroad in 1830, and has been elected every year since. In 1833 he drove the first freight car that moved over the road between South Amboy and Bordentown. Horses were used that year. The first locomotive was imported from England; it is now standing in the shops at Bordentown, and is known as "Johnny Bull" and "Number One."—*Railway World.*

DURING a meeting of the council of the Royal Academy on Wednesday evening last week, Mr. Edward Middleton Barry was rising to address the meeting when he fell back in his chair, and died almost instantly. The medical man who immediately saw him considered the cause of death to be apoplexy. Mr. Barry, who was in his fiftieth year, was the son of the late Sir Charles Barry, and brother of the past President of the Royal Institute of British Architects. Besides being treasurer of the Royal Academy, he was a Fellow of the Royal Institute of British Architects, and won the diploma and gold medal at the Paris Exhibition in 1878 for the best exhibits in architecture. He was Professor of Architecture at the Royal Academy, hon. member of the Imperial and Royal Academy at Vienna, member of the Royal Academy at Amsterdam, and held other foreign distinctions. His last important work was the new building on the Embankment, in the Temple Gardens. Mr. Barry was to have delivered last evening, at Burlington House, the fourth of a course of six lectures on "Architectural Ornament."

## FACTORY NOTES.

MANURE AND SAND-SPREADING MACHINE.—We understand that Messrs. Mowlem and Co., contractors for spreading gravel between Buckingham Palace and Westminster, will partly use one of Messrs. Pamphilon and Co.'s machines for that purpose.

THE DURHAM COKE TRADE.—The officials of Messrs. Bell Brothers at the Rosedale and Ferryhill Ironworks have received instructions to relight other forty ovens, which, with those in operation, brings the number up to 105. Men are being set on daily, and other working places about the colliery are being put in order as quickly as possible for the starting of more hands.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending January 31st. On Monday, Tuesday and Saturday (free) from 10 a.m. to 10 p.m., Museum, 6879; Mercantile Marine, Building Materials and other collections, 1002. On Wednesday, Thursday and Friday (admission 6d.) from 10 a.m. till 4 p.m., Museum, 1093, Mercantile Marine, Building Materials and other Collections, 31. Total, 9005. Average of corresponding week in former years, 14,723. Total from the opening of the Museum, 18,683,329.

CLEVELAND PRODUCTION.—About 100 blast-furnaces are now in operation in the Cleveland district, out of 165 erected therein; but, although the number now in blast is 25 fewer than were in operation six years ago, the rate of production at the present time exceeds that of the earlier date. This is chiefly owing to the use of the larger and more productive furnaces. At the present time the actual production of Cleveland pig-iron from the furnaces in the North-eastern district has been raised to close upon 2000 tons per month each on the average.—*Northern Echo.*

SOUTH LANCASHIRE AND CHESHIRE COALOWNERS' ASSOCIATION.—The monthly meeting of the members of the above Association was held, on Tuesday, at the Queen's Hotel, Manchester, Mr. Pilkington, the president, in the chair, but there was no business of any very general interest brought forward. A number of railway Bills which are to be introduced during the next session of Parliament were considered, but with the exception of the North Staffordshire Bill, where the proposed charges for mineral traffic were considered to be excessive, there was nothing in the clauses calling for any special action on the part of the Association.

YORKSHIRE BOILER INSURANCE COMPANY.—The annual meeting of the shareholders of this company was held at the offices in Tyrrell Street, Bradford, on Monday last, Mr. George Hodgson, chairman of directors, presiding. Mr. John Waugh, engineer to the company, read the report. It stated that during the year just closed the company had made over 4000 external examinations, 50 internal inspections, and 1000 thorough or entire examinations, being 84 per cent. of the boilers under insurance. Over 100 engines had been inspected and indicated. After each of these visits a report had been forwarded to the owner as to the defects, if any. Out of about 1000 defects detected and reported upon no less than 66 were found to be, and so reported, "dangerous."

THE FACTORY AND WORKSHOP ACT.—An order of the Home Secretary has been published to the effect that the 39th section of the above-mentioned Act, setting forth that a child, young person, or woman should not be allowed to take a meal, or to remain during the times allowed for meals, in the parts of the factories or workshops to which the section applies, shall be extended to every factory or workshop in which white lead is manufactured, except any room thereof used solely for meals, and every part of a factory or workshop in which part dry powder or dust is used in the processes of lithographic printing, playing card-making, fancy box-making, paper-staining, almanac-making, artificial flower-making, paper-colouring and enamelling and colour-making. The order will come into force on Monday next.

THE TRUCK ACT.—An important case under the Truck Act came before the Stourbridge magistrates lately. John Glazzard, horse-nail maker, summoned his employer, Samuel Watchhorn, for paying him £4 17s. 7d. other than in coin of the realm in the last two months, and in a second summons he claimed the foregoing amount for wages. It appeared from the complainant's evidence that he entered the defendant's service in November, and was at work at 1s. per bundle under market price. All the actual cash he had received since then was 1s. 4d., the rest being in provisions, including some beer and tobacco. There was practically no defence, but it was urged that the defendant was a young beginner in business. The Bench fined him £2 and costs for the truck offence, and in the second case ordered him to pay the full amount of wages in cash. The complainant, therefore, is now paid twice for his work. The Bench told the defendant that a second offence would involve a penalty of £20.

THE LEYCETT COLLIERY EXPLOSION.—On Tuesday evening the prosecution of the manager, Robert Stevenson, and William and George Burgess, butties at the Leycett Colliery, in connection with the explosion there in September last, came to a close at Hanley. The charges against Stevenson were that he neglected to exercise proper control and supervision over the men and that he neglected to adequately ventilate the mine, and omitted to render true reports of the state of the ventilation. The prosecution was ordered by the Home Secretary, and the evidence of the Government Inspector of Mines went to show that the working of the pit, which had been but lately opened, had been conducted in a manner which must inevitably lead sooner or later to an explosion. William Burgess had contracted to do the work, and he had disobeyed the orders of the manager, who for ten days before the explosion did not enter the pit. For the defence it was urged that the pit was ordinarily safe and well ventilated; that the explosion was due to extraordinary causes; that the reason of Stevenson's absence from the pit was his necessary attendance in another pit where a fire raged, and that he was not required by the Act to descend the mine daily. The charges against George Burgess were dismissed. William Burgess was convicted, but owing to the fact of his lying idle from injuries received in the latest explosion, a mitigated fine of 20s. was imposed. Stevenson was convicted on both charges and fined £5 and costs in one, and 10s. and costs in the other.

RECONSTRUCTION OF MESSRS. HOPKINS, GILKES AND CO., MIDDLESBOROUGH.—On Friday morning the liquidator of this company, Mr. Edwin Waterhouse, despatched to the shareholders a report of the position of affairs. He States that he has, with the sanction of the Court, arranged a compromise of the suit of the South Australian Government for £20,000. The position of affairs is slightly altered by the guarantors of the bank debt having discharged the company's indebtedness to the bank to the extent of £35,714, and having claimed to rank as unsecured creditors for that amount. The creditors ranking for dividend are thus increased to about £10,400, while the bank debt is reduced to about £50,000. The unsecured creditors have now received a dividend of 13s. 4d. in the pound, and the liquidator proposed arranging a continuance of a portion of the debt due to the bank in order to discharge in full the balance due to them in lieu of an issue of debentures. The liquidator states that the engine works of the company, which have been working for the seven and a half months since the liquidation, show a return upon the capital employed of £4312, and he suggests the staying of the liquidation proceedings and the reconstruction of the old company in preference to transferring the assets by sale to a new company. The committee of inspection recommend as members of the new board of directors Sir Thomas Bouch (Edinburgh), Mr. Edward Corner (Whitby), M. H. F. Pease (Darlington), Mr. W. Putnam (Darlington), Mr H. A. Swan (Middlesborough), Mr. Isaac Wilson, M.P. (Middlesborough) and some representative of the Manchester shareholders to be chosen by them.

MANCHESTER STEAM USERS' ASSOCIATION.—The last ordinary monthly meeting of the executive committee of this association was held at the offices, 9, Mount Street, Albert Square, Manchester, on Tuesday, last week, Mr. Samuel Rigby Warrington in the chair. Mr. Lavington E. Fletcher, chief engineer, presented his report, referring to the transactions of the association for the month of December, and also giving a summary of the explosions for the whole year. Of this report the following is an abstract:—"From the 22nd of November to the 31st of December inclusive, 800 visits of inspection were made and 1389 boilers examined; 866 externally, 11 internally, 5 in the flues, and 507 entirely; while, in addition, 6 boilers were tested by hydraulic pressure. Two of these tests were applied to boilers that had already been in use, to ascertain their fitness for the pressure proposed to be carried; while, in the other four cases the boilers were new ones, and were tested not only by hydraulic pressure, but also specially examined, both as regards their construction and complement of fittings, before leaving the maker's yard. During the above period the following defects were met with:—Furnaces out of shape, 3—one dangerous; fractures, 8; blistered plates, 7; internal corrosion, 11; external corrosion, 12—one dangerous; internal grooving, 6; safety-valves out of order, 1; pressure-gauge valves, 45; boilers without feed-back pressure valves, 1; cases of over-pressure, 1; total, 95 defects." The report then gave a condensed tabular statement of the explosions for the whole year, giving the cause of each, with a description of the course of the rents, and the effects produced. From this it appeared that in 1879 there were 25 steam boiler explosions, killing 40 persons and injuring 52 others. Also there were 22 minor explosions, arising from the bursting of kiers, rag cylinders, kitchen and circulating boilers, &c.; these minor explosions killing 15 persons and injuring 36 others. These, added to the steam boiler explosions, brought the return for the year up to 47 explosions, killing 55 persons and injuring 88 others.

THE LABOUR MARKET.—The "helpers" employed in Messrs. Fox, Head and Co.'s rolling mills, Middlesborough, about forty in number, came out on strike on Monday morning, throwing idle close upon 200 men, against the reduction in plate mill wages awarded in September last. The helpers at Messrs. Fox, Head and Co.'s (which firm is not connected with the Board of Arbitration) continued to work at the reduction. Large numbers of workmen employed at Messrs. Palmer's Shipbuilding Yard, Jarrow, turned out on strike on Wednesday. The riveters demand an increased rate of wages, owing to the new class of ships for the American grain trade now ordered to be purchased. The furnacemen and others connected with the Shotts Iron Works have been advanced in their wages to the extent of 10 per cent. Owing to about 30 of the *employés* in the steel finishing department of the Barrow Iron and Steel Works leaving work because they were not content with 5 per cent. advance in wages, in answer to a demand for 15 per cent., the steel department, employing about 1500 men, has been stopped till either new hands are engaged or an arrangement is come to. An adjourned conference of Lancashire miners' delegates was held on Monday at Wigan to consider the wages question. Mr. W. Pickard presided, and about 20,000 men were represented. Owing to the masters declining to grant the applied-for advance in wages, the men decided to discuss the advisability of restricting output. The conference, however, resolved, after a long sitting, to again adjourn for three weeks—the employers having appointed a committee to obtain facts as to the working of the sliding scale in other districts, and the delegates hoping that meanwhile the sliding scale will have been agreed to, or an advance in wages conceded. The question of restricting output was adjourned. On Wednesday, the secretary of the Fife and Clackmannan Miners' Association received a letter from the secretary of the Coalmasters' Association declining to comply with the men's request that they should be provided with a statement of the selling prices of coal which prevailed between May and October last year, in order to enable them to decide as to the acceptance of the proposed sliding scale of wages. Mr. Connel says that the information asked for is a detail following on the adoption of the sliding scale, and that it would be useless to incur the expense and labour of procuring it unless the men will agree to the proposal that the rate of wages shall be 3d. per day for every 6d. per ton of advance in prices—which, for a settlement of the question, the employers have agreed to accept. The South Wales coalmasters held a further meeting at Cardiff on Wednesday, but the business was conducted with closed doors. The state of trade is believed to be improving.

# PARLIAMENTARY NOTES.

## PRIVATE BILLS IN PARLIAMENT.

ON Friday last the Examiner of Private Bills, Mr. Robinson, decided that in relation to the following Bills the standing orders had been complied with:—Malton Gas, Dartford Gas, South Essex and Dengie Flats Reclamation, Edinburgh and District Water, Cardiff Pilotage Board: Bellshill, Motherwell, and Wishaw Railway; Glasgow Faculty of Physicians and Surgeons' Widows Fund; Hyde Gas, Anstruther and St. Andrews Railway, Southern Railway (Cashel Extension Abandonment), Wandsworth and Putney Gas. As to the Benington and Wainfleet Reclamation Bill and the Edinburgh Suburban and Southside Junction Railway Bill, the Examiner decided that the standing orders had not been complied with. The opposition to the Lynn and Fakenham Railway Bill was resumed and continued at considerable length, and the case was adjourned until the 9th of February, the Examiner suggesting that the engineers should in the interim select the principal allegations for argument with a view to spare time. The following were postponed:—Harrow and District Railway, Elham Valley Light Railway, West Wickham and Hayes Railway, Woodside and Croydon Railway, Midland Counties and Shannon Junction Railway, Lea Bridge, Leyton and Walthamstow Tramways; Sligo Borough Water; Giant's Causeway, Portrush and Bush Valley Railways and Tramways; Clare Castle and Ennis Tramway; Ramsgate and Margate Tramways (Extensions, &c.), opposed; Bayswater, Marylebone, King's Cross and Islington Tramways; London Tramway Company, Limited, South London Tramways (Extensions); Glenariff Railway and Harbour (opposed); Taff Vale, Great Western and Merthyr Junction Railway (opposed); Liverpool Tramways (opposed); Metropolitan and Metropolitan District Railway (City Lines and Extensions), opposed; Maldon and Mersea Deep Railway and Pier, Uxbridge and Rickmansworth Railways (opposed); Brentford and Isleworth Tramways (opposed); Downpatrick, Killough and Ardglass Railway; East Norfolk Railway (opposed); Fakenham and Melton Railway (opposed). Mr. Robinson sat again on Monday last, when he decided that in the case of the Southsea Railway Bill, which was unopposed, the Standing Orders had not been complied with. Against the Belfast Central Railway (New Lines, &c.) Bill there were 75 allegations; and against the Belfast, Standtown and High Holywood Railway Bill 40 allegations, the memorialists in both cases being the Belfast, Holywood and Bangor Railway Company. None of the allegations were sustained, and as to both Bills the decision of the Examiner was that the Standing Orders had been complied with. The Cobham Railway Bill, which is opposed, was postponed till Friday. Altogether there were only four Bills on the list, and the business was disposed of at an early hour. On the following day the examiners found that the standing orders had not been complied with respect of the opposed petition for the Taff Vale, Great Western and Merthyr Junction Railway Bill. The examiners, having now gone through the general list of the petition, have adjourned till Friday next. The result so far is that 157 petitions for Bills have complied with the standing orders of both Houses; 13 have not complied, 35 are postponed, one "adjourned," and 6 withdrawn, making up the total of 211 deposited for the Session. The non-compliances and withdrawals are below the average of late years; but the postponed petitions are very much above it. Of the 95 railway petitions 69 have passed, 6 have not passed, 5 are withdrawn, and 15 postponed. Of the 23 tramway petitions 6 have passed, 4 have not passed, one is withdrawn, and 12 are postponed. The Bills to which the petitions that have complied relate may be introduced into one or the other House in the course of a week; but no action can be taken upon any of the unsuccessful petitions, of which seven are opposed and six unopposed, until the standing orders not complied with have been dispensed with in both Houses. The number of Bills to be proceeded with in any event will, comparatively speaking, be very small, and in a professional sense therefore the Session promises to be a poor one, unless indeed there be a good deal of fighting matter hidden in some of the Bills, which, however, according to present appearances, seems hardly likely.

# IRON AND COAL TRADE REPORTS.

**BARNSLEY AND SOUTH YORKSHIRE.**—There is no falling off to note in connection with the iron trade of this district. The works at Milton and Elsecar are working full time, and are producing a good output of merchant iron. The foundries at Thorncliffe and other places in the district exhibit rather more animation, but there is little demand for colliery castings. Very little alteration can be noted with regard to the make of pig-iron, which is just now very largely produced at the furnaces in blast. The Yorkshire Steel and Iron Works at Penistone are in full operations, having, amongst other orders, several for foreign countries on their books. The output of Bessemer steel rails, tires and axles, is great, and a large consignment is weekly taking place. There is more doing at the Don Iron Works, Mexborough, whilst repairs are going on at the Swinton Works, which have been closed for a long time and are about to be reopened. The house-coal trade, both as regards the demand for Silkstones and Barnsley thick-seam is remarkably quiet. Complaints are still general as to the low prices of coal and the inability of the masters to compete with seaborne and London. Prices which were current a fortnight ago are not sustained, and the mild weather experienced during the early part of the week is having a tendency to still further reduce sales. There is very little doing with regard to the Eastern Counties, which, as a rule, are chiefly supplied with house-coal from this district. Steam-coal, on the other hand, is still in fair request, and although scarcely so much has been shipped from some of the ports, the tonnage to Hull, Grimsby, and Goole, is still good. Fuel for engine purposes has, of late, undergone but little alteration, whilst prices are very moderate, in some instances not defraying the cost of production. Makers of coke are still enjoying a lively trade. The output of the best qualities of this class of fuel is increasing, but stocks are pretty well cleared. The smelting trade is holding well up. The question of the sliding scale is being still advocated, and a private meeting of some of the district coalowners was held on Tuesday, respecting the proposed scheme. This is to be followed by a meeting of associated and non-associated coalowners, to be held at Sheffield to-day (Friday) when it is expected the question will be thoroughly ventilated. The men employed at the Barrow Colliery, as stated in our last issue, have resumed work for a fortnight, pending the decision of the the firm, but the strike at Monk Bretton continues, the owners having during the week imported non-union workmen.

**BARROW-IN-FURNESS AND NORTH LANCASHIRE.**—The trade in hematite pig-iron is still very firm, and makers are very well supplied with work. The business doing is almost in every instance six or nine months in advance, as makers have sold the output of their furnaces up to August or September. Generally speaking, buyers who want deliveries completed before the close of the shipping season are asked the full prices current, and makers in some cases are in such a position for orders that in the meantime they are declining to sell; thinking that with a dearth of hematite ore, a great demand for coke which is increasing in value, and a very active enquiry from America and elsewhere for crude iron, prices must even further advance when the shipping season opens. Prices are steadily maintained at last week's quotations both for Bessemer and forge descriptions, while iron ore, which is still very scarce—makers of iron in the district having bought to the close of the year—is very firm at 30s. to 35s. per ton at the mines, although the output of the raw material is rapidly increasing every day by reason of a very spirited development of mining industries. The steel mills throughout the district are fully supplied with orders, and as very large consignments of metal have to be delivered at last year's prices the very novel position has arisen, that defective rails are actually worth more by probably £2 per ton than good rails, inasmuch as the latter are required to meet contracts of some magnitude entered into last year for delivery this year, while the former can be readily sold at much more money. Owing to some difficulty with the men the large steel works at Barrow were stopped during a greater portion of the week, but the mills are again in operation, a settlement having been come to. The iron shipbuilding trade is well employed, but there is a much larger number of workmen coming to the town in this and other trades than employment can be found for. Engineers, ironfounders, and boilermakers are fully employed, and have on hand work at much better prices than they could secure six months ago. Coal is increasing to a slight extent in value. Coke has advanced to from 29s. to 32s. per ton delivered in Furness from Durham ovens.

**BIRMINGHAM.**—A moderate amount of business has been doing in the different branches of local hardware manufacture, but the influx of orders does not increase by any means so rapidly as manufacturers could wish, a result which is no doubt partly to be attributed to the upward tendency of prices. Several export orders have already been referred back, owing to the limit of price rendering it impossible to execute them, and in some cases have been cancelled. The rise in the price of tin, the upward movement in copper, and the sustained high rates for iron, have combined to bring about advances in a considerable number of branches of the local hardware trade. Copper and brass goods (sheets, tubes and wire) have been advanced ½d. per lb., pin wire has gone up 2s. per cwt., the makers of tinplate ware have reduced discount 7½ per cent., and a further reduction in discount has also been announced by manufacturers of tinned and enamelled ware. Advances of more or less importance have also been declared in chains, cables, patent wrought hinges, currycombs, box-irons, brass-headed nails and other goods. Last Saturday Messrs. A. Kenrick and Sons announced by circular, in connection with the recent advance in frying-pans, that, for the future, their terms would be 2½ per cent. for cash monthly, but that quarterly accounts would be nett, carriage at the rate of 1s. per cwt. being paid by them on orders of not less than 24 dozen in one lot. Cabinet brassfoundry manufacturers are also contemplating an advance in prices at an early date. The masters belonging to the coffin furniture avocation have resolved to reduce discounts, which from this date will stand thus:—Common patterns, 75 per cent.; registered patterns, 50 per cent., with 5 per cent. for monthly payments, or 2½ per cent. on journey. Throughout the trade there is, in spite of this very general upward tendency in values, an improvement in the home trade. This is confined chiefly to the metropolis and the larger towns in the districts devoted to the cotton and iron manufacture, from which, owing to the greater activity in these great staples, orders are coming to hand more freely than has been the case for some time past. The discouraging feature is the unsatisfactory demand from the agricultural districts generally, and in these there is no prospect of any early change for the better. A strong export demand for galvanised hollow ware has been experienced, but there is some slackness in orders for sheets. There has been some little improvement in home orders for cabinet brassfoundry, but makers' stocks are heavy, colonial orders being very scarce. The condition of the local iron trade has not varied materially since last week. Sheets have continued in strong demand, and nail and wire rod is scarce and dear. The local demand in other respects is chiefly confined to hinge and girder work, and iron for galvanising purposes. There are, however, unmistakable indications of improvement in the foreign and colonial markets, and the general feeling is that there are fair prospects of a good spring trade. There are still labour difficulties in the district, although they do not threaten to assume any very serious aspect. In the nail trade some of the masters are said to have deviated from the list of prices agreed to at the close of the last strike, and it has been resolved that the men in the employ of these firms should be called out on strike, and supported by means of levies, provided the proposal meet with the consent of the secretary of the new Conciliation Board. In the rivet trade, too, one master is alleged to have acted in a similar manner, and he is to be subjected to the same course of treatment. The small chain and trace makers have given notice, which will expire on the 14th inst., for an advance equivalent to about 12½ per cent. A strike is expected to ensue, but as this branch of trade is in an improving condition, it is not anticipated that the struggle will be one of long duration.

THURSDAY EVENING.—Meeting to-day largely attended, but not much business done, except by middle men, who sold a fair quantity of sheets, strips and bars. Good orders for high-class iron have come to hand by Brazil and West India mail, and American orders for hoops and tinplates still strong. Galvanised sheets in request for India and South America. Little change in finished iron. Prices of sheets rule higher. Common qualities of pig-iron somewhat easier, but high-class firm, there being a good demand for export. Cool market steady but easy.

**CARDIFF.**—The difficulty in giving dispatch to shipments, which began with the sudden arrival of a fleet of steamers (most of them from Bilboa) some weeks ago, has continued chronic ever since. The expansion of the coal-trade during January has been most striking. Stores are heavy, prices are fully maintained at the advance, and freights also are firm. It is, doubtless, the well-grounded apprehension of further advances that has given the spur to purchasers all round. Everything in connection with the iron trade is in the highest state of activity. As an instance, the Llynvi and Ogmoor Iron and Coal Company are consuming all the coke from their 130 coke-ovens, and a quantity of coal besides, and sending unusually large parcels of rails for shipment at the Channel ports. Freights have risen 3s. to 4s. per ton to the States ports, and heavy quantities remain on the wharves awaiting transport. There is a persistent revival of the report that the Abernant and Plymouth works are about to be restarted under Mr. Fothergill's management, as before. Cokemakers continue the most envied of mineral producers. Prices are now 20s. to 23s. f.o.b. New coke-ovens are being erected with all speed, and some firms who found the semi-bituminous character of their steam coal to be its weak point, now find it an unexpected treasure, as rendering the slack suitable for the ovens. As might be expected, the bituminous coals have at last firmly advanced in price—1s. 6d. since December for the best qualities. The same applies with more force to Newport, and some descriptions are not to be had. But, while Cardiff and Newport are thus buoyant, at Swansea the class of coals there shipped do not appear to have gone with the market. The metal trades of that district are, however, in the fullest activity; and those best competent to forecast probabilities, like Mr. Hussey Vivian, M.P., predict for them an onward career of prosperity. Nevertheless, apprehensions are not seldom indulged that the prices of crude iron have been ridden too hard by cliques of speculators; and a deal of injury has been, and will be, done to the finished departments by the impossibility of buying the raw material on good terms. The revival in the iron trade is painfully restricted to one channel—*i.e.*, pigs and rails. Machinists are very badly off for orders, and it is notorious that, since the last advance of the raw material, things have been much quieter. It has been impossible to make a tender for Government work with any certainty; and, if accepted, the founders find they would have been better without it. The large and continuous rolling of rails for contracts made direct with the American and Canadian Railway Companies is a legitimate revival which nothing can disturb; but the action of speculators and middlemen, both on this and the other side the Atlantic is tending to bring things to the point which may start the silent, unprofitable ironworks in the States, and interfere with the demand for importations from the United Kingdom. A check to these apprehensions is given by the "rise" of all provisions in the States, which means the full employment of labour; but it remains true that the multifarious finished-iron industries, tin plates excepted, are in no condition to support the abnormal values now ruling for the crude material.

**CLEVELAND.**—There was rather a moderate attendance on 'Change at Middlesborough on Tuesday and not much business done. The average quotation for No. 3 was 60s. 3d. for immediate delivery, but influenced by the Scotch market the closing price was 60s. There is still a demand for forge-iron beyond the supply, but the price is tending towards its normal position. The ironmasters' returns for the month of January have just been issued and, as expected, are favourable in character. The increase in make of Cleveland iron upon December amounts to 6453 tons, and of the total make 9045 tons. There has been a decrease in makers' stocks upon December of 16,665 tons, but there has been an increase in stock in public stores of 6626 tons, and in makers' stores of 1827 tons. The nett decrease in stocks is thus 8202 tons. The shipments have been very favourable considering the season. The shipments foreign have been 32,370 tons, being 15,123 tons in excess of corresponding month of last year, and the shipments coastwise 46,571 tons, being 24,067 tons in excess of corresponding month last year. There are seven more furnaces in blast now than there were a year ago. In the finished-iron trade the same activity continues. Engineering and ironfounding also are becoming busier. The Eston Steel Works are employed night and day hurrying forward their extended plant. All things are fast brightening, the minor branches of industry having now begun to feel the improvement in the times. The Tees shipwrights have at length arranged with the masters and a strike has been averted. Some minor strikes have taken place amongst the labourers and helpers of the ironworkers, but they are in course of adjustment, if they are not already settled. The coal and code trade continues to improve.

**DERBYSHIRE.**—Most of the works in this district devoted to the production of merchant iron, rails, &c., are doing a fair business, and hopes are entertained that the revival in trade is now a permanent one. A full average output of pig-iron is being made at the furnaces throughout the district, whilst in one or two instances preparations are being made to increase the output. A fair business is being transacted at the Bessemer steel works as well as by waggon builders and machinists. The coal trade is active, but prices are very low. Representatives of Yorkshire collieries in London report that there has been a decline of 1s. per ton recently at some of the pits in this district to metropolitan consumers at a time when seaborne coal is selling at very moderate prices. The quantity sent to London, notwithstanding the low prices, is not so large as might be expected. Most of what is being sent is on account of contracts which have been placed with district firms. There is a fair demand for steam-coal for smelting and other purposes, whilst the coke trade is well up, and seems likely to continue. The local demand for coal is only moderate, and should the present mild weather continue this will doubtless be the case for some time.

**DURHAM.**—There is as yet no abatement in the revival of trade. Not merely the iron and coal trades, but other interests depending upon them begin to feel the improvement. The Weardale and Shildon Water Company, whose works supply all the leading parts of the Durham pit district, is beginning to feel more demand for water. In January, it was stated at the meeting of the company at Darlington on Wednesday, there were four million gallons more water consumed for manufacturing purposes, and there is every reason to believe that the lean dividend of which the shareholders complained—3¼ per cent.—will before the year is out be converted into something much more satisfactory. The Consett Iron Company has just declared an interim dividend at the rate of 5 per cent., and it is satisfactory to learn that the company have not only large orders in hand which will keep their plate mills—equal to the production of 1500 tons of plate per week—going for a long time, but that they find it necessary to build another blast-furnace in addition to the six they have already in blast. It is such concerns as the Consett Company, with all the minerals in their hands and everything that they require to make the finished articles at a cheap rate, which can either in bad or good times pay their shareholders. The standing of the company is shown by the fact that their shares with £7 10s. paid, have lately been at £25 10s.—£18 10s. premium. The West Stockton Works have this week been started for the production of puddled bars. The works at Darlington are doing fairly well, and orders are being got in. The railway engineering works are steady, though there is no pressure of work reported, the demand of the company being chiefly for mineral waggons. The pig-iron market has scarcely been so firm, but the figures for manufactured iron have been very strong. Plates have been quoted up to £9 10s., iron rails (light) £9, bars £8 10s., angles, £8 15s. to £8 17s. 6d. The coke trade, though moderately firm, has not been so active this week. Prices are about as last quoted, and the rates for manufacturing coals do not show any material change. There is a better demand for steam sorts, and they are about 8s. to 8s. 6d. f.o.b. Wear.

**FOREST OF DEAN.**—The home industry of this district still continues to be characterised by inactivity and depression, and notwithstanding the strengthening of quotations in South Wales, the merchants are adhering to their assertions that Forest proprietors were not content with a good trade at substantial prices, but by indiscreetly advancing quotations in December, making 2s. a ton advance, they drove away the trade. There is certainly a semblance of truth in the remark, but whether the "situation" is not the result of a ring—as is alleged—becomes a question of some little uncertainty. According to well believed maxims Forest proprietors can at all times command an active market for their produce when their prices are at no further variance than 1s. per ton as compared with competing districts. This has been generally found to be the case, although at the present time it is not so—f.o.b. prices being respectively, for best house-coal—Forest 12s. 6d. Welsh, 11s. 9d., with a refusal to accept contract for prospective delivery. The Forest proprietors had recently held a meeting but resolved to make no reduction hence the inactivity prevails in full force and apparently the trade is going to other districts. There is no doubt that owing to the severe agricultural depression and general bad times through the country consumers are contenting themselves with the cheaper classes of fuel, and is taken without consideration as to district. This opinion is strengthened by local experience, it appearing that at pits where the fuel is not of the first quality, and consequently sold at lesser rates, the collieries are fairly well off for orders. At Lydney Docks the shipments for January, 1880, were 14,438 tons against 23,313 for the same month last year. From the Cinderford Valley, per Great Western Railway, the tonnage was 21,500 January this year against 29,500 for January last (1879). The Forest iron trade increases in interest, and the Messrs. Crawshay, "catching" the spirit of the times, have blown in a third furnace at Cinderford. Pig-iron is in active request, and prices are rapidly advanced since Christmas. It is stated upon unquestionable authority that the new Parkend firm promoted by Messrs. McEwen and A. D. Morison is progressing, and that very shortly a further announcement may be anticipated. The iron ore trade is assuming a degree of activity not equalled for some years past. In all directions mines are being reopened, and others are worked with increased vigour. Best ores have gone up a hundred per cent. since the spring of last year. Iron wire commands an active market, and the same observation may be applied to the tin-plate industry. Messrs. Richard Thomas and Company, tin-plate makers of Lydbrook and Lydney, have announced their intention this week of assimilating South Wales arrangements at their local mills.

**GLASGOW.**—The warrant market has fluctuated considerably this week, the unsatisfactory reports from America, combined with the fall in other metals, exercised a depressing effect and led to heavy selling, and this chiefly by "bears," as holders seem sanguine that much higher prices will again be reached. Last week 3942 tons of pig-iron were shipped to the United States, besides 2930 sent to Liverpool. On Thursday the market fluctuated between 68s. 6d. and 69s. 3d. cash, and 69s. and 69s. 6d. a month, remaining steady next day at 68s. 2d. to 68s. cash and 69s. to 68s. 6d. a month. On Monday William Band and Co. declared a reduction of 7s. per ton in their prices, and this caused warrants to drop from 67s. 3d. to 65s. 3d. cash and 67s. 9d. to 66s. 1½d. a month. On Tuesday 65s. 7½d. to 65s. cash was accepted. On Wednesday prices fluctuated between 65s. to 66s. 4½d. cash and 65s. 7½d. and 66s. 10½d. a month. Closing sellers, 66s. 3d. cash and 66s. 9d. a month, buyers 3d. per ton less. Makers have not been selling much iron recently, and prices have accordingly been reduced. No. 1 Gartsherrie is now 77s., No. 3 67s. per ton. Iron is still going into Connal's store and the stock there is now 437,236 tons. The shipments of pig-iron from Scotland last week were:—Foreign, 8884 tons; coastwise, 4498 tons (including two weeks' shipments from Leith), against 4968 in the corresponding month of last year. The imports of Middlesborough pig-iron into Grangemouth last week were 3120 tons, against 2460 tons in the similar period of last year. The total imports till February 1, 1880, are 37,395 tons, against 18,013 tons till February 1, 1879, showing an increase for this year of 19,382 tons. The manufactured iron trade is quieter. Though the works are fully employed few new orders are received yet prices are firmly maintained. The exports last week were small, the chief items being locomotives for Spain valued at £5000, sewing-machines for the Continent at £4734, and wrought-iron tubes for Halifax and Boston valued at £1491. The prospects of the shipbuilding trade continue to be encouraging; several new contracts for large ships have been placed with Clyde builders, and it is reported that Messrs. J. Elder and Co. have secured an order to build a steel-plated man-of-war for the Argentine Republic. Founders and engineers generally are receiving a quiet and steady flow of orders, but a great many men in these branches are still unable to find employment. The coal trade is dull; shipping qualities are not in much request, and house coals steady.

**LANCASHIRE.**—The iron trade of this district remains in much the same position as last week. In the pig-iron market the amount of business doing has been of a limited character, and cheap second-hand lots of outside iron have been offered for prompt delivery by dealers and merchants. This, of course, has had a tendency to weaken the market, but makers generally are so fully sold for the present that they are not affected by any temporary depression of values and as a rule they continue firm in their prices. In Lancashire pig-iron there is no material change to report. For forge-iron there is still plenty of enquiry, but the actual amount of business doing is restricted, as makers have little or nothing to sell, the orders already in hand being in some cases sufficient to carry them well into next quarter. Foundry iron still meets with only a limited demand, but of this description of iron there is not very much offering. For delivery into the Manchester district prices all round remain at about 70s. per ton, less 2½ per cent. In outside brands the business doing at present is chiefly through merchants, who in many cases are underselling makers to the extent of about 1s. to 2s. per ton. Middlesborough iron for prompt delivery into the Manchester district is offered at about 68s. 4d. per ton nett, cash, but for delivery over the second quarter about 72s. per ton is being asked. Lincolnshire and Derbyshire irons delivered into this district are quoted by makers at about 75s. 6d. to 76s. 6d. per ton, less 2½ per cent. A very brisk tone continues to prevail throughout the finished-iron trade of this district, and for bars, hoops, sheets and plates there is an active demand, both on home account and for export. Makers generally are so full that it is difficult to place further orders at present, except when they have not yet received specifications for orders already booked. Prices are much the same as last week, ordinary Lancashire bars delivered into the Manchester district being quoted at £9 5s. to £9 10s. per ton. Generally the engineering branches of trade are still without material improvement, although there is a more hopeful feeling. Some of the tool makers report increased enquiries as preliminary to business. The machine makers seem to have a more promising season before them, but the improvement in the cotton trade is not yet sufficiently pronounced to justify any large activity in the machine shops. The shipbuilding trades and, as a consequence, marine engineering show signs of activity, but locomotive builders, although they are still fairly employed on old orders, have not at present much new work in prospect. In the coal trade there is, contrary to general expectation, only a very dull tone. It is not that there is not actually more coal going away, but the increased demand has been more than covered by the increased output of the collieries, and the result is that the supplies in the market are quite as abundant as ever. For best coals there is only a poor demand, and where the pits are going full time stocks are accumulating. The lower classes of round coal meet with a fair enquiry, and in the cotton districts engine fuel is meeting with an increased demand. In prices there is an easier tone, and to clear off stocks colliery proprietors would in most cases readily make a concession upon late rates. The average quotations at the pit mouth are about as under:—Best coal, 8s. 6d. to 9s.; seconds, 6s. 9d. to 7s. 6d.; common round coal, 5s. 6d. to 6s.; burgy, about 4s.; good slack, 3s. to 3s. 3d.; and common, 2s. 3d. to 2s. 6d. per ton. The shipping trade is very dull, and at Liverpool there are large quantities of Lancashire steam-coal offering in the market, but orders are difficult to obtain except at a reduction upon late rates. The coke trade continues brisk and prices are very firm.

**LEEDS AND WEST YORKSHIRE.**—That which is the mainstay here of the manufactured iron trade—namely, the manipulation of the best Yorkshire iron—does not make much progress. All the puddlers' and millmens', and other artificers dreams' of full time are far yet from being realised. This must be so, and even something almost as bad as can be, when, as is the case in the instance this week, a workman at a forge—say a puddler—who last week had four days' work, this week has not had more than a single day. There may be something in the background which the ordinary observer cannot be aware of, to account for this, but, nevertheless, the fact is as here stated. Perhaps this case, so unfortunate for the employes, is an exception to the general rule. The demand experienced by the Low Moor Company for best Yorkshire iron is quite satisfactory; but, so far as Bowling and Farnley are concerned, it might be on a much larger scale before anything like the full resources of these large establishments would be fully in operation. At Monk Bridge Ironworks, where both best and common irons are wrought, there is full work in amplest sense of the term. From 12 p.m. on Sunday to 12 p.m. on Saturday the men and the machinery are kept going. Prices of best iron never fluctuate much, but some of the makers have such large stocks of good pig that sometimes there may be the temptation to take orders at "a drop," though that, it is believed, has not actually happened so far. The prices of ordinary manufactured iron in Leeds are:—Bars and angles, £8 7s. 6d. to £8 17s. 6d.; plates, £9 7s. 6d. to £9 12s. 6d.; less 9½ per cent. as usual. No. 1 Middlesborough pig are 74s. 6d. to 78s.; No. 3 ditto, 67s.; No. 4 foundry, 66s. 9d.; No. 4 forge, 68s. net cash. Our ironfounders do not seem to think that present rates will be much longer maintained. Nevertheless, they are beginning to cover themselves on the orders they have accepted. The nailmakers are busy, and talk of working night as well as day. We understand that the men at one nailworks have struck for the return of a percentage which was taken off their wages some time ago, and the matter is not settled yet. There is no change to report in the engineering, tool and machinery trades. In coals there is more business doing both on home and export account, but no change in prices has occurred, though the probability of it is much talked of.

**LONDON.**—The metal market here exhibits some symptoms of restlessness, although there is no feeling of permanent relapse. Prices have fluctuated in tin and copper—the former especially. From £100 per ton, foreign tin receded to £93 in a few days, and again has advanced some £2. English ingots have not followed to such an extent, but offers at £2 under last week's price. In iron we have been rather quieter. Pigs are easier. Sellers of Scotch are to be found at 5s. Manufactured iron holds its position without sign of yielding. Lead quiet, with slightly easier tone in price. English, £19 to £19 10s. Tin plates not much inquired about, compared with what has been. Makers, however, are well booked.

**NORTH LINCOLNSHIRE.**—Few districts devoted to the manufacture of pig-iron and the production of ironstone present a more lively aspect than North Lincolnshire at the present time. The whole of the available furnaces are now in full blast, and a large and increasing business is being done in pig-iron. Several shipping orders for America and France have recently been completed, in addition to those placed on home account. The erection of two new furnaces at the Trent Works, in the place of the three recently demolished, is progressing, but some time must elapse before they are ready for work. At one of the other works an old furnace is undergoing repairs, and will be lighted as early as possible. The weekly output is now nearly double what it was last year. There is also a lively business doing in iron ore for smelting purposes, and at the present time the number of hands employed in this branch is large. An extensive tonnage is passing over the Manchester, Sheffield and Lincolnshire Railway to Yorkshire, Derbyshire, and other places, owing to the increase in the iron trade. It may also be stated that a new field of iron ore has been broken into at Caythorpe, near Grantham, in the same county, and that fully 100 men are now employed in mining the stone which is near the surface, and in close proximity to the railway. Special sidings have been constructed, and an average tonnage of about 240 per day is being sent away to various places. The stone is said to be plentiful and of good quality.

**NORTH STAFFORDSHIRE.**—The ironworks of this district are still very busy working off orders on the books, and a considerable number yet remain undisposed of, but there is a decided falling off in the receipt of new orders, and the home market continues in a somewhat quiet condition. This state of things, however, does not receive an unfavourable interpretation, as it is believed to be due to the difficulty of getting orders executed with anything like despatch in the present crowded condition of the order books. It is thought that as soon as makers are in a position to entertain offers, and promise a reasonable delivery, plenty of business will be forthcoming, both on home and foreign account. Inquiries for American customers are numerous, and there is no sign of any termination to the heavy demands for that quarter. The hoop mills are fully employed, and there is a considerable demand for plates, both for boiler and ship purposes. Prices of finished iron of all kinds are very firm, and manufacturers still decline to enter into specifications except at an advance. The pig-iron trade is very active, and some heavy lots are leaving the district, but makers are full of orders, and quote only *bona fide* specifications. A large quantity of ironstone is changing hands at advanced rates. Coal maintains a brisk sale, but the supply meets the requirements.

**SHEFFIELD.**—The improvement in the trade continues, and the larger mills are each week becoming much busier. Though there is no smart advance in the price of pig, rates are gradually tending upwards again, and we hear that some mills are suffering from a short supply of hematite. The reaction in the iron trade is likely to prove more important than was at first imagined; and it is now certain when the prices of the day will be maintained for many months to come. Fresh orders are coming in for iron from the States and the demand for manufactured descriptions is heavier on Continental as well as home account. Rates for manufactured iron, are gradually being increased as fresh work comes in, and the prices of raw material and finished goods are now more nearly assimilated than has been the case since the revival. The chief increases noted in prices are in the Bessemer steel department, where rates have gone up so rapidly that those who are holding stocks bought even in October last have now nearly double value in their hands for their purchases. Hematite steel purchased in October, and freely offered in the market at £4 15s. per ton, is now selling freely at £8 10s. We may, however, state that the steel made by the Siemens process shows even a greater increase in value. Stocks which were purchased so lately as the middle of November last at £7 15s. per ton are this week quoted at £14 2s., and even at that price it is almost impossible to obtain supplies. One instance has come under our notice this week where Siemens steel was asked in quantity and £14 per ton offered for it in the ingot. At this rate it was unobtainable, and later on we have been acquainted with the fact that £15 has been realised for a favourite brand of steel ingot made under this process. It may be as well to state that there are exceedingly heavy enquiries in the market for steel wire, and as the quality of steel just alluded to is the best for the purpose, the demand far above the average. The means of supply are very limited, and until the works become more regularly employed it is to be expected that Siemens steel will increase in value even out of proportion to the increased cost of the raw material used in its manufacture. Coming to the old staple trades of the town, we find that notwithstanding public statements to the effect that there is no improvement in the trade, there is one. It matters not in what branches of the old trades you enquire, the workmen state they are better employed, and that they are obtaining more wages than has been the case for at least three years past. Many of the Sheffield firms have introduced machinery for the purpose of turning out a more regular article. This is especially noticeable in cutlery manufactories. In those departments where it has been introduced the greatest activity prevails. However, a genuine demand is springing up both on Continental and home account for better class hand-made goods. In the meantime, ivory, hard woods, and other *et cetera* necessary for the production of cutlery in its various branches, are rapidly advancing in value. We may state the ivory alone within the past three weeks has advanced 20 per cent., and this is caused by the increasing orders for handles and scales used for better class work in the Sheffield trades. The coal market is only depressed. The miners are at variance with their masters. The masters, taking advantage of this, decline to make any further concessions in wages. Rates in the meantime are at a standstill, and although the consumption of coke is on the increase, the means to supply it are so large that any augmentation of rates may not at present be anticipated.

**SOUTH STAFFORDSHIRE.**—February promises to bring a considerably larger amount of new business than marked January. Hardware manufacturers are confidently looking forward to the realisation of this hope. The japanners and tinplate-workers are meeting with an improved season trade, and Scotch orders are coming in capitally. The announcement received this week that the leading Birmingham firm of japanners has advanced prices 10 per cent. increases the dissatisfaction in Wolverhampton, that, in consequence of the opposition of the chief firm there, no advance is yet possible in that town. The fender and fire-iron trade of Dudley is mostly quiet, but a better Australian business is reported by one or two makers. The galvanisers intimate that a further rise in their quotations for sheets will be necessary, seeing that the spelter syndicate have this week declared a further £1 per ton advance, making the price of ordinary qualities £21 15s. at the outports. The tinplate mills keep fully employed, and the American demand is heavy. One local firm have just booked an order on United States account that will take three months to execute, and the price is to be that prevailing at the time of delivery. Finished iron of most descriptions, excepting boiler-plates, continues to find the machinery at the mills and forges full employment, though the "list" houses are not all busy. New orders are less plentiful. Prices are nominally unaltered, but, in reality, are slightly weaker.

**WEST CUMBERLAND.**—The demand for hematite pig-iron is well maintained, and makers are daily in receipt of inquiries from buyers who are desirous of making purchases for forward deliveries before the spring season opens. On the other hand, sellers, who have, speaking generally, entered into large engagements, are reticent in effecting sales except at the full prices current, and when long-delivery engagements are made the values are even higher than those quoted. The price of all-round qualities of Bessemer iron is 130s. to 135s. per ton at makers' works, and of No. 3 forge about 5s. per ton lower than these quotations; 140s. has been mentioned as a quotation, but business has not been transacted at this figure. Towards the close of last week the market displayed evidence of weakness, but a revival set in again, and prices did not move, although there was an easier tone in the demand. The amount of hematite now going into consumption is considerably greater than at any previous period in the history of the trade, and it is evident that the present year will witness the greatest development ever known in the hematite industries of this country, for the demand experienced, both from producers of Bessemer and Siemens steel, is such as to keep thoroughly well employed the producing plant at work at present, as well as that which is being prepared for work at an early date. The advance of the period when steel is to supersede iron is looked forward to with much interest, as the development of the steel age will undoubtedly bring with it a very active state of things for this district. Shipbuilders are likely to be busier, and the finished-iron trade is very well employed, so much so, in fact, that it has been found necessary, in order to cope with the demand, to increase the producing power of the district. Coal is in large consumption by local manufacturers, and also on domestic account, but the requirements of the Irish market are considerable. Native coke in good demand at advanced prices.

# CONTINENTAL MINING AND METALLURGY.

## FRANCE.

THE Comité des Forges publishes the following returns of French metallurgical imports and exports for the years 1878 and 1879 respectively:—Imports: Pig, 166,487 tons and 153,864 tons; irons and plates, 69,965 tons and 73,841 tons; steel 6173 tons and 6896 tons. The exports, all classes together, were 168,704 tons and 164,322 tons. The total imports for 1879, amounting to 234,600 tons, are lower by 8024 tons than the imports for 1878, the difference being caused by the large falling off in the imports of pig-iron shown above, the imports of other classes of goods being slightly in excess of those of 1878. The exports for 1879 are 1277 tons above those of the preceding year, the increase being only at the rate of 1·9 per cent. It is sufficiently clear that the theory of American demands has no application whatever to the revival in France, which is at least as strongly accentuated as in England. This theory we have already had occasion to criticise as shallow and fallacious, and the low condition of the export trade of France, compared with the activity of its internal trade, gives support to our criticism. Ore exports fell off in 1879, owing no doubt to an improvement in the home demand, the figures for 1878 and 1879 are 79,537 tons and 66,652 tons, thus distributed:—

| | 1878.<br>Tons. | 1879.<br>Tons. |
|---|---|---|
| Belgium .. .. .. | 49,024 | 38,641 |
| Germany .. .. | 26,406 | 26,395 |
| Other countries .. | 4,107 | 2,217 |

The falling off in the exports was at the rate of 16 per cent. The imports of ironstone were 1 per cent. higher last year than the year before; the fluctuations in the qualities imported are worth noting. France imported from—

| | 1878.<br>Tons. | 1879.<br>Tons. |
|---|---|---|
| Belgium .. .. .. | 150,831 | 67,001 |
| Germany .. .. | 168,082 | 207,203 |
| Spain .. .. .. | 215,432 | 249,433 |
| Italy .. .. .. | 99,292 | 122,781 |
| Algeria .. .. .. | 294,966 | 289,327 |
| Other countries .. | 3,617 | 6,067 |
| Total .. | 923,220 | 941,812 |

There is a smart decline in the imports of Belgian ironstone, and generally a rise in the imports of the higher qualities of ores, those used for steelmaking, the preference, however, being accorded to Spain rather than to Algeria, from which country there was a slackening of importation.

The following weights of metal passed the city bars at Paris during the eleven months of 1879:—Iron, 34,102 tons; castings, 23,444 tons; giving differences in favour of 1879 as against 1878 of 5788 tons and 4032 tons respectively.

The quotations at Paris, noted by the Comité as official, are 220 fr. (£8 16s.) for No. 1 merchant irons, 230 fr. (£9 4s.) for beams and 250 fr. (£10) for common sheets. These rates are below those quoted by us last week; but they are probably behind them as well by some two or three weeks, the last meeting of the Comité having been held on the 19th ult. "A general view of the present situation enables us to declare," so reads the *Bulletin* of the Comité, "that beyond the rise in rates already effected, there exists a tolerably general tendency towards a fresh advance." The *Bulletin* proceeds:—"Our survey of the situation has shown us at the same time that the important demands which have given rise to the present advance, and seem likely to sustain it for some time yet to come, have sprung up abroad. The present improved condition of trade is not at all the result of any bettering of our own market any more than it is the work of French ironmasters. The advance is but the inevitable consequence of the scarcity and dearness of raw material, which has been swallowed up by English and American buyers, and is of less value to French ironmasters than might be supposed."

If English and American buying has been so strong in France, how is it, in the name of wonder, that French exports have fallen off 16 per cent., taken all together, as against 1878? Long since we pointed out in these columns that the opportunity for the indoctrination of the French mind into free-trade principles must take place in a period of prosperity. The Comité wishes to blink the fact of the advent of this prosperity, for the general purpose of discouraging the advocacy of free trade, and for the very special purpose of maintaining, before the country and the Government, at this particular moment, that the iron trade is more or less in a state of collapse and ruin, owing to the insufficiency of the present duties on imported metallurgical goods. The tonnage of old rails and scrap bought in France on American account has not been so vast as to have altered the conditions of trade all over France, and we wonder that the hardworked stalking-horse of "American demand" has not been walked off its legs long since. The present "revival" is endemic for each country participating in it, is based upon newly-developed conditions in trade, manufacture and politics, and will run its course, probably, in some twelve or eighteen months from now, to be followed in turn by a fresh period of stagnation. With the expansion of facilities for production, has come a disposition to substitute short-time contracts for long-term contracts, and to hold back until markets have fallen to their lowest point. If half the furnaces now on blast were laid cold, and half the mills dismantled, the remainder would run from year's end to year's end, as was at one time the case in England.

*L'Ancre* reports that the advance makes progresss in the principal groups of the North, East, Centre, and South, and is extending to establishments in the neighbouring districts. The Nord forgemasters met at Maubeuge on the 22nd ult., and the situation was found to be such, that they were unwilling to take fresh business at any price at all. Some business was taken a fortnight ago at 220 fr., but not a fourth of what was offered, and business at 230 fr. has been turned away. A very heavy order was offered at 240 fr., but was declined on the ground that the end of the year was too soon for delivery. It will not be long before 250 fr., or £10, is paid for current business in the Nord. English offers of pig at 110 fr. (or £4 8s.) delivered are coming into the department. At present the rate is thought too high, but, as stocks are getting low, and as, for some time to come, no pig can be brought from Eastern France by way of canal, the English offers may eventually be taken. The rate offered would rule all supplies throughout the present year. Business has already been done at 105 fr.

In the Ardennes prices were, on January 1st, on the basis of 180 fr. This has been raised to 200 fr., and now to 220 fr., and will be raised again, perhaps, by another 20 fr. shortly.

The situation in the Centre is thus described in a letter from St. Etienne:—"There is something feverish in the rise which is taking place. Buyers are fairly frightened, and spare no entreaty, no intrigue, to get their orders placed. The railway companies are conspicuous runners in the present steeple-chase for getting in first with orders, both for rolling stock and fixed plant. The last competition at Rennes having had no result, the managers of the State railways called the forgemasters together again and raised the maximum from 250 fr. to 270 fr., but the latter higher price has not yet been accepted by them. Merchant irons have risen with startling rapidity: they stand now at 230 fr.; No. 2 plates are 300 fr. A curious characteristic of the present situation is the general ignorance of the trade as to the proximity of the revival. It has come on merchants and forgemasters as a surprise and so rapidly that they have really not had time to profit by it. I must except, however, one keen-witted merchant at Lyons, who stocked himself as full as he could hold, signed heavy contracts, and will have realised a fortune in a winter. Creusot has sent out a new price list, carrying its standard rate up to 230 fr. (£9 4s.), and warns customers that rates are only to be taken as from day to day. Offers have come in from America to Creusot for rails." We may add that in the single month of January Messrs. Schneider increased their standard rate by £2 per ton.

It is perhaps as well that the Waddington Ministry went out of office before it had opportunity to discuss the great question of the customs tariff. This question is now in the hands of the strongest Government which France has had since the fall of the Second Empire, and it has been promptly entered upon. On Saturday last the Minister of Agriculture and Commerce, M. Tirard, made a strong and decided stand, on the part of the Government, for free trade. In a country so little revolutionary as France, any sudden change in sentiment, any large adoption of large views, is of course not to be expected; but the country has at all events had laid before it in a very able manner the whole of the argument available on the side of free trade, and M. Tirard's speech has brought great credit both to him and his cause. We give in full that part of it with which the iron trade is more especially concerned:—"Gentlemen, there is another trade which stands weeping and lamenting, the iron trade. It is protected not completely, but excessively; it enjoys a protection which averages 40 per cent. on imported goods. Yet the Tariff Commission, fearing lest the Government should take the present tariff as its groundwork, raises the duty on pig-iron [?] from 60 fr. to 70 fr. per ton. I have declared to the commission that it was impossible for me to accept so horrible an increase. The 60 fr. duty is an enormous one, and weighs heavily on a number of small industries depending on the iron trade. I have said that the Government would endeavour to maintain the present duty, but that it was not possible unless we wished to crush these minor trades, to grant a higher protection. And I have done well, as you will see. The manufacturers of iron, like the manufacturers of cotton, have got into a habit of being ruined. From loss to loss, from ruin to ruin, they are now almost all millionnaires. I was told, You will see, that it is impossible to lower the iron dues, France needs all the protection it can get. And yet a protectionist paper, published at Saint-Dizier, published figures a short time since showing that if French ironmasters chose to sell in England or Belgium, they had a margin of 10 fr. per ton to cover themselves. It is impossible to give way to these demands, or to raise by a centime duties already so enormous." The only gain, however, of which we can be sure on this side, is that the treaty principle will be officially accepted, and that the English Government may thus be allowed an opportunity of co-operating with the French in the establishment of principles of progress.

The new steam-water engine invented by M. Testud de Beauregard was publicly tested on December 13th, at the Town Hall of the Fourth Arrondissement, at Paris. The inventor is preparing a plan for the daily demonstration of his invention, at 166, rue de Lafayette; meanwhile, he has a specimen apparatus at work at his private house. Between the hours of 4 and 7 p.m. persons interested in steam can call at his house and inspect the apparatus.

The exhibition of agricultural machinery at the Champs Elysées, in connection with the Paris Cattle Show, was opened on the 29th ult.

Pit-coal has risen to 14 fr. in the north of France; manufacturing coal of all kinds is in strong demand.

BELGIUM.—At Charleroi prices are no longer discussed, the term of delivery being the principal object of bargaining. Order books all round are so full that new business has the greatest difficulty in getting placed. Merchant irons are at £8 to £8 8s. at Charleroi; split irons have slackened a little, and do not bring at Antwerp more than £8 to £8 5s.; but beams are becoming firmer again at £8, makers reckoning on much higher rates in the spring. Bolts are at £12, and clamps at £11; Paris points, £14. Quotations are nominal merely, each new contract being really negotiated on its own merits. The prices of iron, and through them the rates for pig, are influenced to some extent by the demand for iron rails on American account. For common profiles £8 8s. (f.o.b. Antwerp) is readily got; and contracts are offered on these terms for deliveries over the year 1880, and even up to the spring of 1881. Belgian forge pig has touched £3 16s.; and grey foundry £4. On the 28th ult. the State railways opened tenders for the supply of 10,000 tons of iron rails. The following offers were received, only one of which was for the whole quantity:—

| | | | |
|---|---|---|---|
| Acoz .. .. | 10,000 tons | 60 fr. | cash. |
| Monceau .. | 2,750 ,, | 60 | ,, |
| Boucquéau .. | 1,500 ,, | 60 | ,, |
| Couillet .. | 1,500 ,, | 64 fr. 50 | ,, |
| Sclessin .. | 1,500 ,, | 65 | ,, |
| Thy-le-Château | 1,500 ,, | 70 | ,, |

the State giving a ton of old rails for each ton of new. The delivery of the new rails will extend over the year up to August, and the delivery by the State of the old rails will therefore be delayed till next autumn. The disinclination of forgemasters to engage for the whole quantity shows that there is no general belief in the continuance of the present factitious prices of old rails. The *Cote libre* heard on the 30th ult. of old rails having been sold at Charleroi at 130 fr. (£5 4s.) per ton. Will they, with the swift changes of modern markets, keep up their price a twelvemonth? And if they do, the State is paying 190 fr. (£7 12s.) for iron rails—the same rate at which, only a month ago, the Liége mills took contracts for steel rails. A great demand for rails is springing up in all directions, and the Belgian rail mills are hoping for a great harvest of profit.

The Charleroi *Moniteur industriel* states that the ironworks and forges in Hainault have their way clear to next July or August, thus confirming the account sabove given. The Charleroi Chamber of Commerce has petitioned the Minister of Public Works, the much-memorialised M. Sainctelette, to enlarge the rolling-stock of the Belgian State railways. It is beyond doubt that the heavy traffic of Belgium has grown, and is growing, considerably.

GERMANY.—The rapid rise in the cost of raw materials led to some apprehension lest the cost of finished goods should lag behind But the prices of finished manufactures have risen so rapidly that the due proportion between cost and selling price is well maintained. Pig, however, especially forged-pig, is scarce, and scrap is in strong demand. Westphalian mills and forges are pretty generally booked forward up to the turn of the half year, and there is a general confidence in the permanence of the revival. Quotations are merely nominal. The rail mills no longer give a ten years' guarantee with their goods; they and the railway companies agree in thinking a five years' guarantee sufficient. Plates are in almost as strong demand as rails.

Mr. Hensinger v. Waldegg publishes the following summary of Bessemer statistics for Germany, giving the number of converters existing in 1879, thus :—

| | | Converters. |
|---|---|---|
| Prussia :— | | |
| Krupp, Essen .. .. .. .. | | 15 |
| Bochum Steelworks .. .. .. | | 7 |
| Rhenish Steelwork, Neiderich .. .. | | 6 |
| Hermannshütte Hörde .. .. .. | | 5 |
| Königshütte, Upper Silesia .. .. | 4 | |
| Osnabrück Steelworks .. .. .. | 4 | |
| Dortmund Union .. .. .. .. | 4 | |
| Gutehoffnungshütte, Oberhausen .. | 4 | |
| | —16 | |
| Hösch, Dortmund .. .. .. | 2 | |
| Bochum Stahlindustrie .. .. .. | 2 | |
| Phönix, Laar, Ruhrort .. .. .. | 2 | |
| Pöusgen and Giesbert, Düsseldorf .. | 2 | |
| Rothe Erde, Aachen .. .. .. | 2 | |
| Steinhäuser Hütte, Witten .. .. | 2 | |
| | —12 | |
| | | —61 |
| Saxony :— | | |
| Königen Marienhüttes Zwickau .. .. | 4 | |
| Döhlen Steelworks .. .. .. .. | 2 | |
| | — | 6 |
| Bavaria :— | | |
| Maxhütte, Regensburg .. .. .. | 2 | |
| Gebr. Gienatth, Kaiserslautern .. .. | 2 | |
| | — | 4 |
| Alsace-Lorraine :— | | |
| Dietrich and Co., Neiderbronn .. .. | 2 | |
| De Wendel and Co., Hayange .. .. | 2 | |
| | — | 4 |
| | | —75 |

This gives a total of twenty Bessemer works, with seventy-five converters.

In spite of the hindrances occasioned by the severity of the weather, the works of the Düsseldorf Exhibition are being pushed forward, and there is every hope of its opening on May 9th, the date fixed on. The masonry work of the principal structure is up, and presents a frontage of 1000 feet. The whole building will be but little less than that of the Sydney Exhibition, and of about half the dimensions of the 1878 Exhibition at Paris. Agricultural machinery will be shown by close on 100 firms.

A professor from Aachen publishes in the journal of the Berlin Society of Arts an account of a technical tour recently undertaken by him in England and Scotland. He describes works and apparatus without comment, but it is remarkable to see the intelligent attention given by him to the means for technical and professional education existing in Great Britain. He approves of our system of articling engineering pupils. "The English pupil acquires, by the outlay of time on practical work, a wider range of practical skill than is usual with us. And by being easily brought into connection with workmen, he easily learns to know the peculiarities of this class of people better than our students. But the time given to practice is too long, and it could well be shortened in favour of systematic scientific training. The necessity for theoretic training is beginning to make itself very generally felt."

On January 5 the Verein zur Beförderung des Gewerbfleisses, the Berlin Society of Arts just referred to, entered into its 60th year of existence. The Society numbers 671 members, and has Dr. Wedding as the editor of its *Journal*. The Technical Committee of the Society is just now occupied with studying the phenomena of welding in iron.

AUSTRIA.—Merchant brands have gone up 10s. per ton in Bohemia; in Inner Austria the prices of the Forgemasters' Association are well maintained; in pig, steel blooms, and rails there has been some good business done, especially on export account. The make of pig of the Innerberg, Hüttenberg, and Vordernberg furnaces is engaged forward all through 1880, as is the making of steel of the Hüttenberg Bessemer Works and the Styrian Ironworks. White pig has risen from 46 fl. to 52 fl., Bessemer pig from 47 fl. to 60 fl. The Hungarian sheet mills have raised their prices for sheets all round by combined action, the rise being 5 fl. per ton from Jan. 15.

ERRATUM.—In the last paragraph under "Germany" of our last week's notes, for "The steelworks . . . is making 50 tons a day of Thomas steel," read "The Rhenish Steelworks . . . are making," &c.

## NEW PATENTS.

ALL the Patents are placed Alphabetically, with the official numbers attached. The New Applications range from No. 347 to No. 462, being the entries from Jan. 27th, to Feb. 2nd.

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**Aerated Beverages.**—*S. C. Davidson, Belfast.* [361
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**Ammonia from Bones, &c.**—A communication.—*C. Kesseler, Berlin.* [441
**Anchors.**—*J. Whyte, London.* [456
**Anti-Fouling Composition.**—*T. Trebell, Limehouse.* [368
**Bicycle Lamp.**—*H. Salsbury, London.* [355
**Bicycles.**—*S. Davies, London.* [372
**Boot and Shoe Manufacture.**—*F. Clayton, Navan, Ireland.* [349
**Carding Engines.**—*J. Tattersall, sen., and J. Tattersall, jun., Preston.* [393
**Carpet Beating Machinery.**—*S. Simmons, London.* [427
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**Cloth Manufacture.**—A communication.—*A. C. Henderson, London.* [451
**Cutting Glass.**—A communication.—*W. F. Lots, London.* [387
**Designs on Leather.**—*F. Burc, Paris.* [418
**Dextrine, &c.**—*A. L. Bruce, G. Stenhouse, W. McCowan and A. Haddow, Edinburgh.* [366
**Disinfecting Apparatus.**—*G. A. Harvey, Lewisham.* [397
**Distemper Painting.**—*F. W. Ingram, London.* [400
**Drawing Instruments.**—A communication.—*A. V. Newton, Chancery Lane, London.* [357
**Drilling, &c., Machinery.**—*W. Bowker, Manchester.* [416
**Drinking Flasks.**—*H. A. Stanton, London, and A. J. Owen, New Thornton Heath, Surrey.* [424
**Dyeing Cotton Black.**—A communication.—*E. Pestell and R. Peters, Bradford.* [445
**Electric Lamp.**—*T. H. Blamires, Huddersfield.* [455
**Electric Lamps.**—*J. P. C. de Puydt and J. Cougnet, Brussels, Belgium.* [350
**Explosive Compound.**—*M. Tschirner, San Francisco, U.S.A.* [447
**Extracting Metals from Ores.**—A communication.—*W. R. Lake, London.* [458
**Feather Dusters.**—A communication.—*J. Andrade, London* [433
**Floating Dock and Lift.**—A communication.—*G. F. Redfern, London.* [408
**Folding Bedsteads.**—A communication.—*A. M. Clark, Chancery Lane, London.* [431
**Foot Warmers.**—A communication.—*C. D. Abel, London.* [382
**Frame for Drying Clothes.**—A communication.—*A. M. Clark, London.* [413
**Fustians and Cords.**—*W. Wilcock and D. Greenwood, Pecket Well, near Hebden Bridge, Yorkshire.* [419
**Gas Generating Furnaces.**—A communication.—*G. E. Vaughan, London.* [444
**Gas Lamp and Burners.**—A communication.—*J. C. Mewburn, London.* [457
**Gas Lighting.**—*J. Bradshaw and J. Haworth, Blackburn.* [390
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**Hat Boxes.**—*W. Dickinson, sen., Manchester.* [376
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**Iron and Steel.**—*S. G. Thomas, London.* [388
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**Ladies' Wearing Apparel.**—*I. Pick, London.* [386
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**Long Span Bridges.**—*A. Barclay, Kilmarnock.* [367
**Marking Cheques, &c.**—*H. Martin, Barking, Essex.* [439
**Match Box.**—A communication.—*W. R. Lake, London.* [403
**Metal Fencing.**—*J. A. R. Main, R. R. Main and J. Dick, Glasgow.* [373
**Metallic Bedsteads.**—*J. Trobridge, Balsall Heath, Worcestershire.* [364
**Metallic Tubes.**—*J. Atkinson, Leeds.* [371
**Milling and Fulling Machines.**—*J. Armitage, Hanging Heaton, near Dewsbury.* [421
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**Nails for Boots and Shoes.**—*T. Owens, London.* [448
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**Oil Cans.**—*J. Heselwood and H. Webster, Leeds.* [454
**Paper Making Apparatus.**—*D. Smith, Little Eaton, Derby.* [406
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**Perambulators.**—*J. Walterworth, Hull.* [354
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**Plaiting Machines.**—A communication.—*H. J. Haddan, London.* [370
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**Screw-Helm.**—*J. Fricot, Demeurement à Chateaugontiex, France.* [443
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**Taps or Cocks.**—*A. H. Williams, London.* [437
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**Window Sashes.**—*W. Riley, Keighley, and S. C. Taylor, Morecambe, Lancashire.* [398
**Work Boxes.**—*H. Knuth, London.* [420
**Wool Velvet.**—A communication.—*A. C. Henderson, London.* [452
**Writing Desks.**—*C. Barker, Taversham, Norfolk.* [407

NO MORE GAS IN DAYTIME.—More than 30,000 of Chappuis' Daylight Reflectors are fitted up in London only, by which means gas is done away with, and the places rendered cheerful and healthy, added to which a considerable economy is effected. Prospectus sent on receipt of two stamps addressed to (I) Chappuis, 69, Fleet Street, London.—[ADVT.]

## COMMERCIAL.

### SOUTH WALES COAL AND IRON SHIPMENTS, DECEMBER, 1879.

THE foreign coal and iron shipments in December were large, but not so large as they have been in previous months during 1879. The coastwise shipments, however, indicate a greater demand for coal in the country, and from every port they are on the increase. The increased demand is but the prelude for the masters asking higher prices, and this seems to be the case, as in the early part of 1880 masters required an advance of 6d. per ton. The demand in the foreign market seems only about equal to the average, but the stimulus given to the iron trade causes the consumption of coal at home to be greater, and as a necessary result there is not that active competition to supply the foreign market, and an advance in the prices is required. The shipments of iron are increasing, espacially from Cardiff, where the exports are largely in excess of former months.

To our contemporary the *South Wales Daily News* we are indebted for the following returns of shipments :—

SOUTH WALES SHIPMENTS, DECEMBER, 1879.

| | Coal. | Iron. | Coke. | Pt. Fuel. |
|---|---|---|---|---|
| Cardiff .......... | 349,516 | 10,479 | 826 | 5645 |
| Swansea ........ | 61,920 | 760 | 852 | 10,756 |
| Newport ........ | 76,852 | 5953 | 1018 | nil |
| Llanelly ........ | 4463 | nil | nil | nil |

CARDIFF SHIPMENTS, 1879.

Coal.

| | Coal. | Iron. | Coke. | P. fuel. | Coastwise. |
|---|---|---|---|---|---|
| Jan. | 292,496 | 4,262 | 3,363 | 9,040 | 51,049 |
| Feb. | 337,553 | 4,630 | 746 | 7,885 | 67,679 |
| Mar. | 379,998 | 5,764 | 808 | 14,607 | 73,366 |
| April | 369,367 | 10,004 | 2,038 | 19,313 | 69,883 |
| May | 432,289 | 6,622 | 2,359 | 13,325 | 69,096 |
| June | 351,968 | 4,542 | 1,569 | 11,383 | 64,139 |
| July | 323,483 | 6,180 | 906 | 13,315 | 56,182 |
| Aug. | 366,192 | 13,852 | 1,229 | 5,579 | 69,171 |
| Sept. | 341,719 | 12,376 | 651 | 10,337 | 81,367 |
| Oct. | 364,388 | 13,004 | 2,834 | 9,407 | 76,610 |
| Nov. | 344,709 | 8,323 | 699 | 3,664 | 76,546 |
| Dec. | 349,516 | 10,479 | 826 | 5,645 | 70,506 |
| | 4,253,678 | 99,668 | 17,528 | 122,500 | 826,044 |

NEWPORT SHIPMENTS, 1879.

| | Coal. | Iron. | Coke. | Coastwise. |
|---|---|---|---|---|
| Jan. | 84,402 | 6,295 | 15 | 74,540 |
| Feb. | 57,163 | 8,788 | 90 | 87,076 |
| Mar. | 81,315 | 2,546 | nil | 86,922 |
| April | 77,495 | 3,474 | 25 | 79,295 |
| May | 101,415 | 5,546 | 130 | 75,825 |
| June | 72,528 | 4,694 | 106 | 82,054 |
| July | 69,340 | 10,831 | 139 | 71,971 |
| Aug. | 76,419 | 5,113 | 1,250 | 83,473 |
| Sep. | 65,405 | 8,758 | 687 | 81,992 |
| Oct. | 85,185 | 3,262 | 1,012 | 86,179 |
| Nov. | 90,493 | 5,527 | 632 | 83,308 |
| Dec. | 76,893 | 5,953 | 1,018 | 77,259 |
| | 938,012 | 70,787 | 5,413 | 983,558 |

SWANSEA SHIPMENTS, 1879.

| | Coal. | Iron. | Coke. | P. fuel. | Coastwise. |
|---|---|---|---|---|---|
| Jan. | 55,735 | 80 | 79 | 13,076 | 41,797 |
| Feb. | 48,915 | 263 | 83 | 14,382 | 40,116 |
| Mar. | 62,297 | 169 | 808 | 12,300 | 51,665 |
| April | 58,412 | nil | 15 | 9925 | 52,424 |
| May | 61,410 | 46 | 1234 | 22,375 | 54,143 |
| June | 47,732 | nil | 167 | 13,728 | 46,808 |
| July | 55,006 | 405 | 70 | 10,181 | 40,775 |
| Aug. | 55,846 | 1080 | 79 | 13,755 | 44,437 |
| Sept. | 53,675 | 922 | 314 | 17,647 | 42,301 |
| Oct. | 54,002 | 772 | 507 | 16,370 | 59,020 |
| Nov. | 61,469 | 1368 | 400 | 5,832 | 52,314 |
| Dec. | 61,920 | 760 | 852 | 10,756 | 4,427 |
| | 676,419 | 5833 | 4608 | 160,027 | 543,207 |

LLANELLY SHIPMENTS, 1879.

| | Foreign. Coal. | Coastwise. Coal. |
|---|---|---|
| January | 7,119 | 5,904 |
| February | 2,306 | 6,032 |
| March | 8,686 | 9,749 |
| April | 7,532 | 12,264 |
| May.. | 6,201 | 12,591 |
| June | 6,729 | 9,235 |
| July.. | 3,722 | 12,258 |
| August | 6,683 | 9,276 |
| September .. | 4,744 | 12,108 |
| October | 7,783 | 9,359 |
| November .. | 5,649 | 10,726 |
| December .. | 4,463 | 6,811 |
| | 71,127 | 116,383 |

SHIPMENTS FOR THE WHOLE COUNTRY FOR DECEMBER, 1879.

The coal shipments for the whole country for December were larger than has been known for some time. The total shipments were 1,343,032 tons; for December, 1878, the shipments were 1,102,386 tons; and for December, 1877, the shipments were 1,069,607 tons. Of the quantity shipped last month Russia took 19,499 tons; Sweden and Norway, 114,944 tons; Denmark, 100,792 tons; Germany, 114,391 tons; Holland, 18,712 tons; France, 325,837 tons; Spain, 85,281 tons; Italy, 132,450 tons; Turkey, 19,127 tons; Egypt, 49,707 tons; Brazil, 22,559 tons; Malta, 14,442 tons; British India, 72,452 tons; other countries, 252,919 tons.

The quantity of iron shipped was in excess of the average, especially for pig-iron, bar iron, and railway iron. The shipments of pig-iron amounted to 80,817 tons; bar iron, 24,177 tons; railway iron of all sorts, 35,877 tons. The shipment of tinplates was also in excess, reaching 16,392 tons; while the shipments for December, 1878, were 11,157 tons. The shipment of steel rails was also far in excess of the usual average. The quantity shipped last month was 20,656 tons; while the quantity shipped for December, 1878, was only

11,855 tons. Of the steel rails, by far the largest quantity was shipped to British India.

Coal Exports from the Whole Country for December.

| | Foreign. | | Coastwise. | |
|---|---|---|---|---|
| | 1879. | 1878. | 1879. | 1878. |
| Newcastle | 302,445 | 221,900 | 274,477 | 270,616 |
| North Shields | 22,641 | 6,620 | 480 | 2,400 |
| South Shields | 20,437 | 23,068 | 34,876 | 35,665 |
| Blyth | 11,460 | 8,514 | 4,276 | 1,803 |
| Amble | 5,913 | 4,254 | 7,475 | 4,960 |
| Sunderland | 70,188 | 77,900 | 206,675 | 200,240 |
| Seaham | 2,325 | 1,550 | 50,130 | 41,792 |
| Hartlepool | 40,736 | 37,268 | 53,285 | 55,937 |
| Ayr | 460 | 933 | 18,987 | 29,371 |
| Middlesborough | 3,894 | 1,588 | 2,469 | 3,436 |
| Hull | 37,328 | 33,541 | 2,455 | 4,112 |
| Grimsby | 18,119 | 18,079 | 852 | 1,358 |
| Liverpool | 46,945 | 27,756 | 40,074 | 2,809 |
| Whitehaven | 309 | — | 18,571 | 12,835 |
| Newport | 76,852 | 69,399 | 77,259 | 85,306 |
| Cardiff | 349,516 | 382,016 | 70,506 | 64,987 |
| Swansea | 61,920 | 68,326 | 44,427 | 15,950 |
| Glasgow | 6,447 | 17,863 | — | — |
| Goole | 15,068 | 12,476 | 3,878 | 2,940 |
| Llanelly | 4,463 | 3,734 | 6,881 | 8,022 |
| Grangemouth | 16,541 | 14,542 | — | — |
| Charlestown | 17,061 | 11,913 | 144 | 1,053 |
| Alloa | 18,957 | 5,400 | 905 | 1,267 |
| Inverkeithing | 398 | — | 364 | — |
| Borrowstoness | 1,645 | 1,332 | 2,786 | 2,328 |
| Irvine | 585 | — | 5,560 | 6,207 |
| Troon | 12,106 | 15,117 | 21,586 | 16,021 |
| St. David's | 8,095 | 2,665 | — | — |
| Dundee | 5,646 | 2,423 | 485 | 280 |
| Greenock | 2,875 | 1,142 | — | — |
| Granton | 8,145 | 8,930 | 4,868 | 6,350 |
| Ardrossan | 4,691 | 2,078 | 15,880 | 16,021 |

Coal Exports for the Whole Country for 1879.

The total quantity of coal shipped from all the shipping ports in the country in 1879 reached 16,435,642 tons exclusive of bunker coal, which amounted to 4,401,129 tons, making a total of 20,839,762 tons shipped to foreign ports, and for the use of steamers trading to foreign ports. The quantity of coal shipped during 1878 to foreign ports was 15,494,638 tons, and for 1877 the quantity was 15,420,050 tons. The shipments for 1879 are, therefore, a large increase on the shipments of 1878. The value of the coal shipped to foreign ports in 1879 is, according to the Board of Trade returns, £7,262,040, while the value of the coal so shipped, though nearly a million tons less in quantity, is returned as £7,330,474. The largest quantity of coal was sent last year to Russia, which took 1,230,766 tons; Sweden and Norway took 1,097,005 tons; Germany, 2,055,387 tons; France, 3,317,578 tons; and Italy, which took 1,370,661 tons.

Total Exports from the Whole Country for 1879 and 1878.

| | Foreign. | | Coastwise. | |
|---|---|---|---|---|
| | 1879. | 1878. | 1879. | 1878. |
| Newcastle | 3,751,794 | 3,343,855 | 9,586,646 | 2,398,470 |
| N. Shields | 226,348 | 210,384 | 719 | 9,063 |
| S. Shields | 358,711 | 263,593 | 238,770 | 157,404 |
| Blyth | 190,557 | 155,808 | 43,597 | 39,112 |
| Amble | 76,504 | 52,298 | 91,369 | 45,571 |
| Sunderland | 1,015,928 | 1,141,821 | 2,091,559 | 2,023,370 |
| Hartlepool | 517,258 | 594,351 | 607,393 | 568,170 |
| Seaham | 35,374 | 44,990 | 558,809 | 535,442 |
| Middlsborough | 28,515 | 31,309 | 46,055 | 47,966 |
| Hull | 412,368 | 450,799 | 51,260 | 37,993 |
| Goole | 255,640 | 231,921 | 87,008 | 64,445 |
| Liverpool | 552,181 | 592,266 | 478,059 | 365,110 |
| Whitehaven | 309 | — | 217,545 | 139,550 |
| Cardiff | 4,253,678 | 4,038,306 | 826,044 | 814,871 |
| Swansea | 676,419 | 686,142 | 543,207 | 241,425 |
| Newport | 938,012 | 772,503 | 983,558 | 877,290 |
| Llanelly | 71,127 | 70,599 | 116,383 | 123,415 |
| Glasgow | 244,786 | 265,383 | — | — |
| Port Glasgow | 10,649 | 6,933 | — | — |
| Greenock | 119,231 | 130,705 | — | — |
| Grangemouth | 118,768 | 161,166 | — | — |
| Alloa | 159,699 | 99,316 | 15,392 | 7,167 |
| Charlestown | 184,534 | 148,927 | 11,376 | 11,206 |
| Borrowstoness | 32,849 | 42,916 | 30,542 | 27,685 |
| Ayr | 7,944 | 9,814 | 354,570 | 374,248 |
| Irvine | 4,787 | 1,695 | 102,189 | 62,305 |
| Inverkeithing | 3,155 | 1,671 | 715 | — |
| Troon | 104,189 | 125,210 | 221,554 | 269,467 |
| Ardrossan | 62,970 | 61,353 | 291,448 | 174,294 |
| St. David's | 54,907 | 43,008 | 872 | 739 |
| Grimsby | 257,016 | 275,698 | 38,399 | 15,736 |
| Dundee | 66,125 | 78,005 | 2,691 | 2,939 |
| Granton | 120,436 | 116,381 | 65,972 | 51,023 |
| Stockton | — | — | 1,222 | — |

## SOUTH WALES IRON SHIPMENTS, DECEMBER, 1879.

SUMMARY of foreign iron shipments from Cardiff, Newport, Swansea, and Llanelly, during the month of December, 1879:—

| | Tons. | | Tons. |
|---|---|---|---|
| Aspinwall | 728 | Brought up | 7,275 |
| Baltic | 70 | Lisbon | 120 |
| Barbadoes | 350 | Madras | 1,877 |
| Bilbao | 196 | New Orleans | 1,622 |
| Bombay | 4,097 | New York | 2,373 |
| Cagliari | 590 | Oporto | 276 |
| Charanal | 32 | Philadelphia | 450 |
| Constantinople | 655 | Porto Torres | 701 |
| Coquimbo | 20 | Salonica | 1,318 |
| Genoa | 305 | Santander | 850 |
| Gijon | 12 | Smyrna | 302 |
| Huelva | 220 | Tucacas | 20 |
| Carried up | 7,275 | Total | 17,184 |

## SOUTH WALES COAL SHIPMENTS, DECEMBER, 1879.

SUMMARY of foreign coal shipments from Cardiff, Newport, Swansea and Llanelly, during the month of December, 1879:—

| | Tons. | | Tons. |
|---|---|---|---|
| Aden | 26,545 | Mauritius | 1,264 |
| Aquadilla | 305 | Messina | 3,609 |
| Alexandria | 8,448 | Monte Video | 3,438 |
| Algiers | 564 | Morlaix | 468 |
| Alicante | 6,412 | Mozambique | 420 |
| Amsterdam | 701 | Muscat | 792 |
| Ancona | 240 | Nantes | 2,348 |
| Archacon | 410 | Naples | 4,525 |
| Aspinwall | 380 | New York | 500 |
| Bahia | 1,765 | Nice | 514 |
| Bancote | 815 | Odessa | 200 |
| Barbadoes | 310 | Oporto | 1,132 |
| Barcelona | 9,285 | Oran | 492 |
| Bari | 235 | Palermo | 5,835 |
| Batavia | 1,220 | Palma | 757 |
| Bayonne | 452 | Passages | 300 |
| Bergen | 581 | Permambuco | 908 |
| Bilbao | 3,803 | Phillipville | 206 |
| Bombay | 14,975 | Point de Galle | 2,131 |
| Bordeaux | 11,128 | Port Audemer | 362 |
| Boulogne | 870 | Port Nolloth | 409 |
| Brest | 874 | Porto Rico | 284 |
| Buenos Ayres | 686 | Porto Torres | 659 |
| Burletta | 260 | Port Said | 33,500 |
| Cadiz | 4,577 | Quimper | 304 |
| Caen | 6,962 | Rangoon | 3,151 |
| Cagliari | 920 | Redon | 553 |
| Cape de Verds | 3,533 | Rio de Janeiro | 16,035 |
| Cape Town | 2,447 | Rio Grande do Sul | 688 |
| Carlo Forte | 285 | Rochelle | 1,100 |
| Carrizal | 530 | Rochfort | 6,610 |
| Carthagena | 1,261 | Rotterdam | 700 |
| Charente | 809 | Rouen | 9,737 |
| Cherbourg | 435 | Sables d'Olonne | 5,057 |
| Cienfuegos | 2,625 | Santander | 925 |
| Constantinople | 11,128 | Santos | 1,315 |
| Coquimbo | 1,777 | Savona | 10,618 |
| Corfu | 1,207 | Sevastopol | 1,100 |
| Dakar | 2,361 | Seville | 1,940 |
| Demerara | 301 | Singapore | 817 |
| Denia | 324 | Smyrna | 310 |
| Dieppe | 27,515 | Spezzia | 2,140 |
| Dunkirk | 337 | St. Brieux | 333 |
| Ensenada | 550 | St. Catherine | 236 |
| Fecamp | 1,499 | St. Croix | 457 |
| Fort de France | 622 | St. Gilles | 750 |
| Genoa | 24,750 | St. Jago de Cuba | 520 |
| Gibraltar | 18,561 | St. Lucia | 2,380 |
| Granville | 902 | St. Malo | 5,589 |
| Guadaloupe | 2,793 | St. Martin | 214 |
| Hamburg | 974 | St. Nazaire | 22,953 |
| Havannah | 8,393 | St. Servan | 561 |
| Havre | 24,020 | St. Thomas | 1,332 |
| Hennebont | 1,063 | St. Valery | 460 |
| Honfleur | 2,283 | St. Vincent | 1,435 |
| Hong Kong | 3,158 | Suaga | 1,003 |
| Huelva | 1,680 | Suez | 3,600 |
| Jamaica | 3,745 | Table Bay | 1,917 |
| Jersey | 246 | Tarragona | 2,006 |
| La Rochelle | 7,775 | Teneriffe | 418 |
| Leghorn | 1,150 | Toronto | 1,500 |
| Lisbon | 3,877 | Treport | 2,341 |
| L'Orient | 653 | Trinidad | 779 |
| Madeira | 220 | Trouville | 4,151 |
| Malaga | 995 | Valencia | 661 |
| Malfetta | 212 | Valparaiso | 2,808 |
| Malta | 11,261 | Venice | 5,500 |
| Manilla | 1,141 | Vera Cruz | 513 |
| Maranham | 368 | Villa Franca | 1,196 |
| Marans | 834 | Shipments under 200 tons | 2,179 |
| Marseilles | 2,851 | | |
| Martinique | 6,780 | | |

## NEW COMPANIES.

Arts Club.—This Company proposes to carry on and manage as a proprietary club, the Arts Club, Manchester. It was registered 23rd ult., with a capital of £3000 in £5 shares.

Blaenavon.—This Company proposes to purchase (subject to an existing mortgage) the freehold and leasehold property, with the works thereon, lately belonging to the Blaenavon Iron and Steel Company, Limited, situate at Blaenavon, in the county of Monmouth. It was registered 22nd ult., with a capital of £200,000 in £100 shares.

Crighton and Ayton.—The object of this Company is to acquire a license to construct, work, and sell one tramway locomotive, according to the provisional specification filed at the Patent Office on 30th of July last by Messrs. Charles Edwin Crighton and John Septimus Ayton, in pursuance of their petition for letters patent for improvements in tramway and other locomotive engines. The Company was registered 22nd ult., with a capital of £1200 in £50 shares.

Danube Steamship Company (No. 1).—With a capital of £8395, divided into 23 shares of £365, this Company was registered 27th ult., for carrying on the business of a steamship company.

"Devonia" Steamship.—Incorporated 24th ult., with a capital of £24,000 in 120 shares of £200 each, to purchase the steamship *Devonia*, now building by the Palmer's Shipbuilding Company, Limited, Newcastle-on-Tyne.

London Dry Docks.—With a capital of £500,000 in £20 shares, this Company proposes to carry on the businesses of dockowners, shipbuilders, shipowners, repairers, furnishers, salvors and breakers, ropemakers, sailmakers, wharfingers, and all other incidental businesses. It was registered 21st ult.

Minerals Company.—The object of this Company is the working, converting and dealing in minerals, stones, earth, clay and peat. It was registered 27th ult., with a capital of £5000 in £10 shares.

Mona Mines.—Upon terms of an agreement of 22nd ult., this Company proposes to acquire the Mona Mines, situate at Amlwch, in the county of Anglesea, with all appurtenances belonging thereto. It was registered 23rd ult., with a capital of £40,000, in £5 shares. The purchase considerations are the allotment to the vendors of 4000 fully paid shares, the payment of £4200 in cash, and a further cash payment of £4000 for purchase of stock.

Plumbley Colliery.—Upon terms of an agreement of 4th of September, 1879 (unregistered), this Company proposes to purchase from Mr. John Rhodes certain mineral lands situate at Eckington and Bramley, in the county of Derby. It was registered 21st ult., with a capital of £25,000 in £50 shares.

Richard Aisworth and Company.—Registered 22nd ult., with a capital of £10,000 in £10 shares, to carry on in Blackburn and elsewhere the businesses of brass and ironfounders, brass finishers, copper workers, engineers and agricultural implement makers.

Tisbury Gas.—Registered 21st ult., with a capital of £2000 in £5 shares, to erect works according to the plans and specifications of Mr. William Cartwright Holmes, for supplying the inhabitants of Tisbury in Wiltshire, with gas and gas products.

Yswith Lead Mines.—This Company proposes to purchase leasehold interest in the South Cwmystwith Mine situate in the parish of Gwns, county of Carnarvon; held under the crown. It was registered 26th ult., with a capital of £24,000 in £1 shares.

## PARTNERSHIPS DISSOLVED.

J. Allison and Co., Star Yard, Carey Street, Chancery Lane, zincographic engravers.—C. Smith and Co., Star Yard, Lincoln's Inn, lithographers.—A. L. Tottenham and F. Barry, contractors for the construction and equipment of the works of the Sligo, Leitrim, and Northern Counties Railway, Victoria Street, Westminster.—Jessie Gittins and Co., Kidderminster, ironfounders.—Watts and Stone, Barrow-in-Furness, railway contractors—J. Ferguson and D. C. Orr, Tidal Basin, Victoria Docks, London, iron-ship cementers.—J. Murray, G. B. Cooper, and J. J. Robinson and I. Wilson, executors of T. Musgrave, deceased, Frizington, Cumberland (under the style of the Frizington Waggon Building Company), waggon builders: and Whitehaven (under the style of T. Musgrave and Co.), ironfounders—G. Horobin and Son, Wolverhampton, bellows, pipe and Ferrule makers.

## LONDON PRICE LIST OF METALS, ORES, OILS, CHEMICALS, &c.

[FOR THE PRESENT AND PAST WEEK.]

(Metal Market, City, Thursday Afternoon, 4 P.M., (*February* 5, 1880.)

### METALS AND ORES.

| | January 29. | | February 5. | |
|---|---|---|---|---|
| | £ s. | £ s. | £ s. | £ s. |
| Copper (per ton)— | | | | |
| Chili, for 90 per cent. | 73 10/ | 73 15/ | 72 10/ | — |
| Wallaroo | 82 0/ | — | 81 0/ | — |
| Burra Burra | 81 0/ | — | 80 0/ | — |
| English Tough | 78 0/ | 80 0/ | 79 0/ | 80 0/ |
| English Ingot best | 80 10/ | 81 0/ | 80 10/ | 81 0/ |
| Sheets sheathing and rod | 82 0/ | 84 0/ | 84 0/ | 85 0/ |
| Bottoms | 86 0/ | 88 0/ | 88 0/ | 100 0/ |
| Ore per unit | 0 13/9 | 0 14/ | 0 13/9 | 0 14/ |
| Phosphor Bronze | | | | |
| Special Bearing Metal (p tn) | 110 0/ | — | 110 0/ | — |
| Other alloys (per ton | 120 0/ | 142 0/ | 120 0/ | 142 0/ |
| Tin (per ton)— | | | | |
| Straits (Cash) | 99 10/ | 100 0/ | 97 0/ | — |
| Do. for arr. | — | — | — | — |
| Billiton | — | — | — | — |
| Banca | — | — | — | — |
| English Ingots | 105 0/ | — | 103 0/ | — |
| Do. Bars | 106 0/ | — | 104 0/ | — |
| Do. Refined | 108 0/ | 109 0/ | 106 0/ | — |
| Australian | 100 0/ | — | 97 0/ | — |
| Tin Plates, per box, I.C. coke f.o.b. London | 0 30/ | 0 32/ | 0 30/ | 0 32/ |
| IX. do. | 0 35/ | 0 40/ | 0 35/ | 0 40/ |
| I.C. charcoal | 0 34/ | 0 36/ | 0 34/ | 0 36/ |
| I.X ,, | 0 40/ | 0 44/ | 0 40/ | 0 44/ |
| Lead (per ton)— | | | | |
| Soft English pig | 19 0/ | 19 10/ | 19 0/ | 19 10/ |
| Do. W.B. | — | — | — | — |
| Spanish soft | 18 10/ | 18 15/ | 18 10/ | 18 15/ |
| Do. with silver | — | — | — | — |
| Sheet milled | 19 10/ | 19 15/ | 19 10/ | 19 15/ |
| Red lead | 20 10/ | — | 20 10/ | — |
| White | 24 0/ | — | 24 0/ | — |
| Patent shot | 22 0/ | 23 0/ | 22 0/ | 23 0/ |
| Zinc (per ton)—from No. 9 Gauge. | | | | |
| Sheets, rolled | 25 0/ | — | 25 0/ | — |
| Do., foreign | 25 0/ | — | 25 0/ | — |
| Spelter (per ton)— | | | | |
| Silesian, com | 21 0/ | — | 21 0/ | — |
| Rhenish | — | — | — | — |
| English | — | — | — | — |
| Quicksilver, bot. | 7 5/ | 7 10/ | 7 5/ | 7 10/ |
| Antimony ore (per ton)— | | | | |
| Australian | 11 10/ | 14 10/ | 11 10/ | 14 10/ |
| Spanish | — | — | — | — |
| French Star | 68 0/ | 70 0/ | 71 0/ | — |
| Regulus— | | | | |
| Crude (per cwt.) | 1 14/ | — | 1 14/ | — |
| Nickel (per lb.) | 0 3/ | — | 0 3/ | — |
| Brass (per lb.)— | | | | |
| Sheets, 48×24. | 0 0/6½ | — | 0 0/8 | — |
| Tubes | 0 0/8½ | 0 0/9½ | 0 0/11 | 0 1/ |
| Wire | 0 0/7½ | — | 0 0/8½ | — |
| Yellow metal | — | — | — | — |
| Asbestos (per lb.) | 0 0/3 | 0 1/ | 0 0/3 | 0 1/ |
| Plumbago (per ton)— | | | | |
| Ceylon lump | 0 17/6 | — | 0 17/6 | — |
| Do. chip | 0 10/6 | — | 0 10/6 | — |
| Do. dust | 8 6/ | — | 8 6/ | — |
| Coals (per ton)— | | | | |
| East Hartlepool | 1 2/ | — | 1 2/ | — |
| Lambton | 1 4/ | — | 1 4/ | — |
| Tees | 1 4/ | — | 1 4/ | — |
| Hartley | 1 2/ | — | 1 2/ | — |
| Hetton | 1 4/ | — | 1 4/ | — |
| Hawthorn | 1 3/ | — | 1 3/ | — |
| Tunstall | 1 2/ | — | 1 2/ | — |

### IRON.

| | January 29. | | February 5. | |
|---|---|---|---|---|
| Iron, per ton (at works)*— | £ s. | £ s. | £ s. | £ s. |
| Bars, Welsh, common | 6 5/ | 6 7/ | 6 5/ | 6 7/ |
| Do. Best | 7 0/ | — | 7 0/ | — |
| Scotch, Common | 8 10/ | — | 8 10/ | — |
| Do. Best | 9 0/ | — | 9 0/ | — |
| South Stafford, common | 8 0/ | — | 8 0/ | — |
| Do. Best | 8 10/ | — | 8 10/ | — |
| Sheets, singles, Cleveland | 9 0/ | — | 9 0/ | — |
| Staffordshire | 9 5/ | 9 10/ | 9 5/ | 9 10/ |
| Do. doubles, Staffordshire | 10 15/ | 11 5/ | 10 15/ | 11 5/ |
| Scotch | 10 5/ | — | 10 5/ | — |
| Do. Lattens, Staffordshire | 12 5/ | 12 15/ | 12 5/ | 12 15/ |
| Plates, Ship, Stafford. | 10 0/ | 10 5/ | 10 0/ | 10 5/ |
| Do. Scotch | 8 5/ | 8 15/ | 8 5/ | 8 15/ |
| Do. do. Stafford. | 12 0/ | 12 10/ | 12 0/ | 12 10/ |
| Do. Boiler, Stafford. | 9 0/ | 10 0/ | 9 0/ | 10 0/ |
| Hoops, Stafford | 8 10/ | 9 0/ | 8 10/ | 9 0/ |
| Nail Rods, Stafford | 7 17/6 | 9 0/ | 7 17/6 | 9 0/ |
| Swedish in Lond. | 11 0/ | 11 10/ | 11 0/ | 11 10/ |
| Angle Iron, Welsh | 7 10/ | 9 0/ | 7 10/ | 9 0/ |
| Do. Stafford | 8 10/ | 9 10/ | 8 10/ | 9 10/ |
| Pud. Bars, Welsh | — | — | — | — |
| Do. Stafford | 6 0/ | 6 10/ | 6 0/ | 6 10/ |
| Do. Scotch | — | — | — | — |
| Rails, Welsh | 8 0/ | 8 10/ | 8 0/ | 8 10/ |
| Do. Stafford | 8 0/ | 9 10/ | 8 10/ | 9 10/ |
| North England | 5 5/ | — | 5 5/ | — |
| Light Rails, Welsh | 8 5/ | 8 15/ | 8 5/ | 8 15/ |
| Do. Stafford | 8 15/ | 9 15/ | 8 15/ | 9 15/ |
| Pig Iron at Glasgow | | | | |
| Scotch warrants | 3 12/ | — | 3 5/ | — |
| Do. No. 1 | 3 13/ | 4 5/ | 3 10/ | 4 0/ |
| Cleveland, Tyne or Tees | 2 1/ | 2 6/ | 3 0/ | — |
| Indian Charcoal, London | — | — | — | — |
| Wrought Iron Girders | 13 0/ | 18 0/ | 13 0/ | 18 0/ |
| Bolts and Nuts | 13 0/ | 15 0/ | 13 0/ | 15 0/ |
| Fish Bolts | 13 0/ | 20 0/ | 13 0/ | 20 0/ |
| Washers | 13 10/ | 14 0/ | 13 10/ | 14 0/ |
| Rivets | 10 0/ | 13 0/ | 10 0/ | 13 0/ |
| Spikes | 12 10/ | 14 10/ | 12 10/ | 14 10/ |

| | January 29. | | February 5. | |
|---|---|---|---|---|
| | £ s. | £ s. | £ s. | £ s. |
| **Swedish Iron—** | | | | |
| f.o.b. Gottenburg, nett cash. | | | | |
| Pig | — | — | — | — |
| Bar, rolled | 11 0/ | 11 10/ | 11 0/ | 11 10/ |
| Do. hammered | 11 0/ | 11 10/ | 11 0/ | 11 10/ |
| Billets | 13 10/ | — | 13 10/ | — |
| Horse Nail Rods | 14 0/ | 14 10/ | 14 0/ | 14 10/ |
| **Belgian Iron—** | | | | |
| f.o.b. Antwerp, less 2½ per cent. | | | | |
| Bars and Slit Rods, common | Nominal. | | | |
| Best | | | | |
| Best Best | | | | |
| Hammered | | | | |
| Puddled Steel | | | | |
| Bessemer | | | | |
| Hoops | | | | |
| Rails | | | | |
| Rolled Girders | | | | |
| **Steel—** | | | | |
| Best cast | 40 0/ | 42 0/ | 40 0/ | 42 0/ |
| Do. dbl. shear | 45 0/ | — | 45 0/ | — |
| Do. single do. | 38 0/ | 40 0/ | 38 0/ | 40 0/ |
| English spring med. quality | 12 0/ | 22 0/ | 12 0/ | 22 0/ |
| Blister | 21 0/ | 34 0/ | 21 0/ | 34 0/ |
| Swedish keg | 16 0/ | — | 16 0/ | — |
| Milan | 25 0/ | 28 0/ | 25 0/ | 28 0/ |
| Bessemer rails | 6 5/ | — | 6 5/ | — |
| Do. tires | 11 0/ | 15 0/ | 11 0/ | 15 0/ |
| Do. billets | 7 10/ | 10 0/ | 7 10/ | 10 0/ |
| Do. ingots | 7 0/ | 8 0/ | 7 0/ | 8 0/ |
| **Scrap (per ton)—** | | | | |
| Old rails for remanufacture, D.H. | 4 0/ | — | 4 0/ | — |
| Ditto flange or bridge | 4 0/ | — | 4 10/ | 6 0/ |
| Engineers' scrap | 3 0/ | 4 0/ | 3 0/ | 4 0/ |
| Light scrap | 3 0/ | — | 3 0/ | — |
| Scrap metal | 2 0/ | 3 0/ | 2 0/ | 3 0/ |
| Old steel scrap | 3 15/ | 4 10/ | 3 15/ | 4 10/ |
| **Wire—** | | | | |
| Best best drawn killed gal. tel., Nos. 0 to 6 | 17 0/ | — | 17 0/ | — |
| Do. 7 & 8 | 18 0/ | — | 18 0/ | — |
| Do. 9 | 18 15/ | — | 18 15/ | — |
| Do. 10 | 19 10/ | — | 19 10/ | — |
| Do. 11 | 20 0/ | — | 20 0/ | — |
| Do. 12 | 21 0/ | — | 21 0/ | — |
| Rolled black fencing wire (per ton) 1 to 4 | 10 10/ | — | 10 10/ | — |
| Do. 5 | 11 0/ | — | 11 0/ | — |
| Do. 6 | 11 10/ | — | 11 10/ | — |
| Do. 7 | 12 0/ | — | 12 0/ | — |
| Bright Iron Wire (Charcoal wire, 4s. 6d. per bundle extra) per bundle of 63 lb. 0 to 6 | 0 13/ | — | 0 13/ | — |
| Do. 7 to 8 | 0 13/6 | 0 13/9 | 0 13/6 | 0 13/9 |
| Galvanised, 80s. per ton extra. | | | | |
| Best best annealed drawn fencing wire, per ton 0 to 6 | 12 5/ | — | 12 5/ | — |
| Do. 7 | 12 15/ | — | 12 15/ | — |
| Do. 8 | 13 0/ | — | 13 0/ | — |
| **Castings (per ton) at works—** | | | | |
| Girders | 6 10/ | 7 10/ | 6 10/ | 7 10/ |
| Chairs | 4 10/ | 5 0/ | 4 10/ | 5 0/ |
| Floor plates | 5 12/6 | — | 5 12/6 | — |
| Pipes, 1½ to 2in. | 6 12/6 | 7 0/ | 6 12/6 | 7 0/ |
| Do. 3 ,, 4 | 6 2/6 | 6 5/ | 6 2/6 | 6 5/ |
| Do. 5 ,, 8 | 6 1/6 | 6 4/ | 6 1/6 | 6 4/ |
| Do. 10 ,,16 | 6 0/ | 6 2/6 | 6 0/ | 6 2/6 |
| Do. 18 ,,24 | 5 17/6 | 6 0/ | 5 17/6 | 6 0/ |
| Bolts and Nuts | 17 10/ | 20 0/ | 17 10/ | 20 0/ |
| Fish Bolts | 18 10/ | 21 0/ | 18 10/ | 21 0/ |
| Spikes | 17 10/ | 18 10/ | 17 10/ | 18 10/ |
| Rivets | 14 10/ | 21 0/ | 14 10/ | 21 0/ |
| Washers | 10 10/ | 21 10/ | 10 10/ | 21 10/ |

* The entire ton consists of ten times 100 kilogrammes, or about 30 lb short of an English ton.

## OILS, CHEMICALS, &c.

| | January 29. | | February 5. | |
|---|---|---|---|---|
| | £ s. | £ s. | £ s. | £ s. |
| **Oils (per tun)—** | | | | |
| Olive, Malaga | — | — | — | — |
| Do. Gioja | — | — | — | — |
| Do. Levant | 45 0/ | — | 41 0/ | 43 0/ |
| Do. Mogador | — | — | — | — |
| Do. Tunis | — | — | — | — |
| Do. Seville | 46 0/ | — | 45 0/ | — |
| Do. Sicily | 45 0/ | 46 0/ | 45 0/ | 46 0/ |
| Seal, pale | 30 0/ | — | 30 0/ | — |
| Seal, yellow | 27 0/ | — | 27 0/ | — |
| Seal, brown | 25 0/ | — | 25 0/ | — |
| Sperm head | 70 0/ | 71 0/ | 70 0/ | 71 0/ |
| Cod | 27 0/ | — | 27 0/ | — |
| Whale, pale | 26 10/ | — | 26 10/ | — |
| Do. yellow | 25 10/ | — | 25 10/ | — |
| Do. brown | 20 0/ | — | 20 0/ | — |
| E.I. Fish | — | — | — | — |
| Rapeseed, English, pale | 31 5/ | — | 31 5/ | — |
| Do. brown | 29 5/ | — | 29 5/ | — |
| Foreign Pale | — | — | — | — |
| Ground nut and Gingelly Madr. | — | — | — | — |
| Palm oil, fine | 35 15/ | — | 35 15/ | — |
| Palm nut oil | 35 10/ | — | 35 10/ | — |
| Linseed oil | 27 0/ | — | 27 0/ | — |
| Cotton seed oil | 29 0/ | 30 5/ | 28 10/ | 29 5/ |
| Lard | 44 0/ | — | 44 0/ | — |
| Cocoanut, Cochin | 38 0/ | — | 38 0/ | — |
| Do. Ceylon | 35 10/ | — | 35 10/ | — |
| Mauritius | 37 10/ | — | 37 10/ | — |
| C. Price & Co.'s patent engine oil (per gal.) | 0 3/6 | — | 0 3/6 | — |
| **Oil Cake (per ton)—** | | | | |
| Linseed, Lndn. | 11 5/ | — | 11 5/ | 11 10/ |
| American bls. | 10 10/ | — | 10 10/ | — |
| Do. bags | 10 12/6 | — | 10 12/6 | — |
| Marseilles | 9 15/ | — | 9 15/ | — |
| Rape, English | 5 0/ | — | 5 0/ | — |
| Do. Foreign | — | — | — | — |
| Green Cotton | 6 0/ | 7 10/ | 6 0/ | 7 10/ |
| **Tallow—**PYC. | 43 0/ | — | 45 0/ | — |
| S.Americn. Beef | 41 0/ | — | 41 0/ | — |
| Do. Sheep | — | — | — | — |
| Australian Beef | 36 0/ | — | 36 0/ | — |
| Do. Sheep | 40 10/ | — | 40 0/ | — |
| Rough Town Fat | 14 0/ | — | 14 0/ | — |
| **Petroleum—** | | | | |
| Fine (per gal.) | 0 0/7 | | 0 0/5½ | 0 0/6 |
| Do. spirit | 0 0/7½ | — | 0 0/7 | 0 0/7½ |
| **Turpentine—Spirit—** | | | | |
| French | — | — | — | — |
| American (casks) | 1 12/3 | — | 1 12/3 | — |
| **Whalefins (per. ton)—** | | | | |
| Davis' Straits | 1100 0/ | — | 1100 0/ | — |
| Arctic | 1000 0/ | 1000 0/ | 1000 0/ | 1000 0/ |
| Southern | 500 0/ | — | 500 0/ | — |
| **Brimstone (per ton)—** | | | | |
| Rough, 2ds Ind. | 7 0/ | — | 7 0/ | — |
| Do. 3rds, do | 5 10/ | — | 5 10/ | — |
| Roll | 8 15/ | — | 8 15/ | — |
| **Sulphur, Flour** | 11 0/ | — | 10 15/ | 12 0/ |
| **Acid, (per lb.)** | | | | |
| Acetic, fine | 0 0/4 | — | 0 0/4 | — |
| Do. common | 0 0/2 | — | 0 0/2½ | 0 0/3 |
| Citric | 0 2/ | 0 2/ | 0 2/1 | 0 2/4 |
| Muriatic fine (per cwt.) | 0 4/ | 0 6/ | 0 4/ | 0 7/ |
| Do. common | 0 4/ | 0 5/ | 0 4/ | 0 5/ |
| Nitric | 0 0/4 | — | 0 0/4½ | — |
| Oxalic (per lb.) | 0 0/5¼ | 0 5½ | 0 0/5¼ | 0 5½ |
| Sulphuric, concentrated | 0 0/0¾ | 0 0/1 | 0 0/0¾ | 0 0/1 |
| Do. Brown | 0 0/0¾ | — | 0 0/0¾ | 0 0/1 |
| Tartaric Crystal | — | 0 1/7 | 0 1/7 | — |
| Do. Pulv. | 0 1/5½ | 0 1/7 | 0 1/5½ | — |
| **Ammonia—** | | | | |
| Carbonate, per lb. | 0 0/6½ | 0 0/6¾ | 0 0/6½ | 0 0/6¾ |
| Sulphate, White & grey (per ton) | 20 0/ | — | 20 0/ | — |
| **Arsenic—** White Lump (per ton) | 23 10/ | — | 24 0/ | — |
| Powdered, do. | 11 5/ | — | 11 0/ | 11 3/ |
| Bleaching powder | 8 6/ | — | 8 9/ | — |
| **Borax**, Rfd., do. | 1 10/ | — | 2 3/ | — |
| **Copperas** (ton) | 2 5/ | 2 10/ | 2 10/ | 3 5/ |
| **Bi-Sulphide Carbon** (per ton) | 24 10/ | 26 0/ | 24 10/ | 26 0/ |
| **Portland Cement—** | | | | |
| 1st quality, in cks 400 lb. gross, inc. csks., f.o.b., Thames, per csk. | 0 9/ | — | 0 9/ | — |
| Do. in sks, 200 lb. net (per ton) | 2 0/ | — | 2 0/ | — |
| Sacks extra, 1/6 each. | | | | |
| Charlton White Paint (per cwt.) | 1 12/ | — | 1 12/ | — |
| Calley's Torbay Paint, Brown | 0 30/ | — | 0 30/ | — |
| Do. Red | 0 34/ | — | 0 34/ | — |
| **Hypophosphites (per lb.)—** | | | | |
| Iron | 0 9/3 | 0 10/ | 0 9/3 | 0 10/ |
| Lime | 0 5/3 | 0 7/ | 0 5/3 | 0 7/ |
| Magnesia | 0 9/ | 0 9/ | 0 9/ | 0 9/ |
| Manganese | 0 9/ | 0 9/ | 0 9/ | 0 9/ |
| Soda | 0 5/3 | 0 6/ | 0 5/3 | 0 6/ |
| **Lead (per cwt.)—** | | | | |
| Acetate,...best | 2 0/ | — | 2 0/ | — |
| Nitrate | 1 15/ | — | 1 15/ | — |
| Red | 1 1/ | — | 1 3/ | — |
| White | 1 3/ | 1 4/ | 1 4/ | — |
| **Litharge** (pr cwt.) | 1 1/ | 1 2/ | 1 1/ | 1 2/ |
| **Lime (per ton)—** | | | | |
| Acetate, Grey, 85% | 0 19/ | — | 0 19/ | — |
| Do. Brown 70% | 11 0/ | — | 11 0/ | — |
| **Potash—** | | | | |
| Bichromate (lb.) | 0 0/6¾ | — | 0 0/7 | — |
| Chlorate (pr.lb.) | 0 0/7¾ | — | 0 0/7¾ | — |
| Muriate, 80% ton | 6 15/ | — | 6 15/ | — |
| Pruss. Red (lb.) | 0 1/8 | — | 0 1/11 | — |
| Do. Yel. lb. | 0 0/11¼ | 0 1/ | 0 0/11¼ | — |
| Sulphate, 80% (per ton) | 14 0/ | 16 0/ | 14 0/ | — |
| **Saltpetre (per cwt.)—** | | | | |
| Engl. refnd. kgs. | 1 7/6 | — | 1 7/6 | — |
| Do. barrels | 1 6/ | — | 1 6/ | — |
| Do. Bengal | 0 19/6 | 1 1/6 | 0 19/6 | 1 1/6 |
| **Soda—** | | | | |
| Ash........ deg. | 0 0/1 15-16 | 0 2/ | 0 0/1 15-16 | 0 2/ |
| Bicarb. (per cwt.) | 0 10/9 | 0 11/ | 0 11/9 | 0 12/ |
| Caustic, 60% | 0 12/6 | — | 0 12/6 | 0 13/6 |
| Do. 72% | 0 13/ | — | 0 13/ | — |
| Nitrate | 0 19/ | — | 0 19/ | — |
| Crystals (per ton) | 4 0/ | 4 2/6 | 4 5/ | 4 7/6 |

* Per ton extra in London, Staffordshire, 15s.; Scotch, 10s.; Lancashire, 15s.; Welsh, 10s.

# PRICES CURRENT OF MANUFACTURED GOODS OF BIRMINGHAM AND DISTRICT.

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The quotations given are merchants' and factors' average prices, dependent, of course, on terms of payment as well as the quality and quantity of goods ordered, and fluctuations in cost of raw material.

The Prices and Discounts quoted are carefully revised every week, and great pains are taken to render this List thoroughly reliable.

Last week we reported advances in shoe heels, brass toddy kettles, brass lock furniture, small chains, tin and japanware; brass wire, sheets and tubes; and copper wire, sheets and tubes. This week again brings in advices of fresh alterations, all again upwards. Most of the ironfounders have now sent out their revised lists of sadirons, furnace grates and bars, Dutch stoves, Cassava plates, clock and sash weights, all of which are advanced 1s. per cwt. all round, except the commonest sorts of sash weights which are only advanced 6d., whereas garden loops and slate pegs in one or two cases show no alteration whatever. The coffin furniture makers, who a few weeks ago reduced their prices, have as suddenly now advanced again reducing discounts 5 per cent. Messrs. Griffiths and Browett have reduced their discount on tin and japanned wares 7½ per cent., and on their tinned and wrought-iron galvanised hollow ware 5 per cent., enamelled wrought-iron hollow ware remaining the same as before. All makers of tin goods have now advanced their prices, and other makers of sheet iron goods are advancing their prices in proportion. The wireworkers have reduced their discount on weaving fenders, fire-grates, machine-made netting, and general goods 5 per cent. all round, and iron and brass chains 72 per cent., and curry combs are advanced 10 per cent. The German silver smelters have advanced the price of ingot and rolled metal 1d. per pound all round, and brass and copper wire sheets and tubes are advanced another ½ per pound. Paris pointes or wire nails are advanced from Nos. 0 to 13 W.G. 1s. 6d. per cwt.; No. 14, 2s.; No. 15, 3s.; No. 16, 3s. The following are now the prices of these:—Nos. 0 to 6, 15s. 6d.; No. 7, 16s.; No. 8, 15s. 6d.; No. 9, 17s. 6d.; No. 10, 18s.; No. 11, 20s.; No. 12, 21s.; No. 13, 22s.; No. 14, 24s.; No. 15, 26s.; No. 16, 28s. Wire slate nails, 1½ and 1¾ inches, 21s. to 24s. per cwt. Blued wire clout nails, fine ⅝ by 14 inches, 37s.; ¾ by 14 inches, 33s.; strong ⅝ by 13 inches, 36s.; ¾ by 12 inches, 30s.; ⅞ by 12 inches, 30s.; 1¼ by 10 inches, 25s.

## ABRIDGED LIST.

**Axles**, 15 to 25%; coach ironwork, 10 to 15%; coach and waggon springs, 15 to 20%; Augers, 10 to 20%. **Axes**.—Ship carpenters', /5½ to /6 per lb.; Kent and house carpenters', /5 to /6; ditto, steel polished, /5½ to /7; felling axes, /4½ to /4¾; polished, /4½ to /6; bright and blued solid steel, /7 to /8; American felling or wedge Axes, steel polished, 1/ to 1/4 per lb.; common **Anvils**, 84 lb. and upwards, 18/6 to 20/ per cwt.; best warranted, 22/ to 24/; ditto, and ends warranted not to break off, 27/ to 35/.

**Basins**, shallow galvanised, 10 inch, 7/ to 7/6 per doz.; deep Basins, galvanised, 12 inch, 10/0 to 12/0 per doz.; Bastard **Bellows**, 42½ to 50%; Best extra nailed Bastard, 37½ to 45%; Best improved long Bristol, 35 to 40%; casters' or moulders', best extra nailed, 12 inch, 30/ per doz. net; common **Smiths' Bellows**, 45 to 50%; Best warranted, extra leather double nailed, 36 to 40%; with movable pipe for shipment 2½% less discount. **Bed screws**, 6 and 7-16 and ⅜ inch, 10/6 to 11/6 per gross for London black heads; London heads with bright turned collar, 6 and 7-16 and ⅜ inch nuts, 12/9 to 13/9; Black welded heads, 9/3 to 10/3; common slit heads, 6 and ⅜ and ½ inch, 9/3 to 10/3; Bright turned notched heads, 6 and 7-16 and ⅜ inch, 12/9 to 13/9; black notched heads, 10/6 to 11/6 per gross; **Brass head nails**, 40 to 42½%; star head, 35 to 40%; Brass plated countersunk head, 25 to 30%; **Blacksmiths' tongs**, 26/ to 28/ per cwt.; real fine wrought **Box irons**, 20 to 25%; fine cast, 42½ to 60%; middle cast, 42½ to 60%; charcoal box irons—Victoria, 45 to 50%; ordinary charcoal box irons, 55 to 70%; **Bolts**—Straight tower; solid end tower, 65 to 67½%; end Best solid tower, 60 to 65½%; solid end barrel brass knob, 60 to 62½%; japanned Scotch tower bolts, 45 to 50%; painters' brushes, 45 to 65%; Best, 10 to 40%; light galvanised **Buckets**, 12 inch, 38 lb. to the doz., 10/ per doz. net; **Blind cord**, list price net; **Bed hooks and eyes**, 50 to 55% malleable, 62½ to 67½%; Brass chain **Beading**, 30 to 35%; Brass and plate coach beading, 30 to 35%; ashpan moulding, 20 to 30%; **Bottle jacks**—Linwood's, 15 to 20%; Salter's, 30 to 35%; Nicholas's, 15 to 20%; common painted **Beams**, 35% to 65%; Bright round end beams, 40% to 55%; Bright box end beams, 40 to 55%; deep **Copper scales**, 45 to 65%; **Steelyards**, 40 to 60%; pocket steelyards, best counter weighing machines, Avery or other best make, 25 to 30%; common, with round copper scale, 7 lb., 3/ to 5/; 14 lb., 3/9 to 5/9; 28 lb., 5/ to 8/ each, net; **Bedsteads**, cheap stump, 6 feet by 3 feet 6 in., 7/6 to 9/6 each; cheap French, 6 feet by 3 feet 6 inches, 8/6 to 10/6 each, rising /6 for every 6 inches. **Brass**—Rolled brass, 2 to 12 inches wide, to 30 W.G., /9½ to /10½ per lb.; Brass sheets, 24 by 48 in., 8 lb. and upwards or 27 W.G., /9¾ to /10¾ per lb.; **House bells**, brass rough, /10 to 1/1 per lb.; turned edge, /11¼ to 1/1; turned, and lacquered on edge, 1/8 to 2/ per lb.; cattle and sheep bells, with brass loops, 1/3½ to 1/6 per lb.; clock bells, 1/9 to 1/10; ship and turret bells best, 1/4 to 1/5 **Battery kettles**, 150/ per cwt.; composition sheathing and **Slating nails**, /10¾ to /11½ per lb.; Brass **Escutcheon pins**, ⅜ by 16 inch, W.G., /10½ to 1/. **Brass jelly pans**, with bails, 1/ to 1/1; without bails, 1/1 to 1/2 per lb. **Maslin kettles**, cast, 4 to 16 inch, /10½ to 1/ per lb. **Pinpoints**, 1/4 to 1/5. Brass **Rivets** for boots, 12 to 17, W.G., /10 to /11 per lb. Brass **Shoe Bills**, 1/1½ to 1/2½ per lb. Brass **Scale pans**, 2/ to 2/2; Brass **Toddy kettles**, 15 to 20%. Brass **Tubes**, plain rough, ⅜ inch and above, /10½ to /11¼ per lb. Locomotive and marine boiler tubes, seam less from 1⅜ to 4 inch outside diameter, to 14, W.G., /8¾ to /9¾.

**Copper**.—Copper **boat nails**, wrought 1½ by 12 inch, W.G., and upwards, /10½ to 1/1 per lb. Copper 1 boat **Roves**, ½ inch and upwards 1/2½ to 1/3 per lb. Copper **Brads and bills**, same price as tacks. Light round Copper **Kettles**, bare rivets, 1/11½ to 2/ per lb. Light round covered rivets, 1/10 to 1/11½; loaded, 1/8 to 1/9; oval Copper kettles, bare rivets, 2/3 to 2/4 per lb.; oval bare rivets raisedown, 2/5 to 2/6 per lb. Copper **Rivets** and washers, 1/ to 1/1 per lb.; Copper **Slating nails**, cut, 1 to 1½ inch and upwards, /11½ to 1/ per lb.; Copper **Scale pans**, 1/11 to 2/2 per lb.; cut Copper **Nails and tacks**, 1 inch and upwards, 1/ to 1/1 per lb.; wrought Copper nails and tack, 1/5 to 1/6 per lb.; Copper **Wire**, 0 to 20 W.G., /10½ to /11. Brass **cupboard turns**, 45 to 52½%; **Chair webbing**, No. 9, 4/5; 10, 4/8; C9, 4/1; C10, 4/6 per gross of 66 yards; **Carpet rings**, 1/ to 1/6 per gross; **Cornice poles**, 2¼ inch, brass best burnished, 4/6 per foot, 25 to 35%, 3/4 covered; brass poles, 1/2 per foot, 25 to 35, imitation mahogany cornice poles with ends and rings complete, 2¼; inch, 1/ per foot; light birch ditto, 1/1 to 1/2 per foot; real mahogany, 2/1 to 2/6 per foot; cornice pole rings, brass, 2¼ inch, light, 2/9; middle, 3/7; strong, 4/2 per doz., 20 to 30%; wood cornice pole rings, 2¼ inch, imitation mahogany, 16/ to 18/ per gross net; light birch, 17/ to 19/; real mahogany, 22/ to 25/ per gross net; machine made wire **Chain**, single link, iron, 42½ to 47½%; double link, iron, 37½ to 47½%; single link, brass, 37½ to 47½%; registered double link, brass, 32½ to 37½%; close link brass Chain, 5 to 10% brass oval lamp Chain, 27½ to 27½%; brass Clock Chain, 22½ to 27½%; japanned pillar Chains, 1 yard, 16 by 6, 6/8 to 7/6 per doz.; japanned manger, 1½ yard 16 by 6, 8/3 to 9/6; japanned rack, 1 yard, 18 by 6, 5/6 to 6/6; japanned dog, 1½ yards, 12 by 7, 6/6 to 7/6; 2 yards, 14 by 6, 11/ to 12/; **Cowties**, a chain, or Derbyshire, 8/ to 10/; open ring, 8/ to 10/; close ring, 7/ to 8/ per doz.; japanned watering chains, 14 by 6, 4/9 to 5/9; tinned watering chains, 5/ to 6/; bullock chains, ⅜ inch hook at each end, 19/ to 20/ backbands, 10/6 to 20/6; short link Chain, plain or twisted, ⅜ inch, 18/ to 20/; ½ inch, 16/ to 18/; 1 inch, 14 to 16/ per cwt.; Cart and plough traces, 21/ to 23/ per cwt. **Chesthandles**, improved japanned, 75 to 77½%; broad plate, strong and extra strong, 15 to 55%, according to strength; railway **Cotterpins**, 55 to 60%; Brass **Curtain rings**, 37½ to 42½%; Brass **Chair nails**, 40 to 45%; square box **Coffee mills**, 25 to 50%; Common post Coffee mills, 20 to 30%; best brass bushed mills, 40 to 45%; London mills, 35 to 40%; registered **Coffin furniture**, 45%; Common, 70%.

**Door springs**, X, 75 to 80%; XX, 70 to 72½%; XXX, 65 to 67½%; XXXX, 55 to 60%; brass circular and iron circular, 55 to 60%; brass reliance, 10 to 15%; climax, 5 to 10%; universal, 50 to 60%; paragon, 10 to 15%; smiths', 10 to 15%; O'Connor's patent lever hinge springs, 10 to 15%; O'Connor's vertical spring hinge door spring, 15 to 25%; Gerish's spring hinges, iron, 20 to 25%; brass, 10 to 15%; japanned **Door chains**, 30 to 60%.

**Files**, 25 to 50%; **Frying pans**, best, 45 to 50% common, 52 to 57½%; kitchen **Fireirons**, in sets, /6 to /7 per lb.; tongs only, /6½ to /7; pokers only, /5¾ to /6 per lb. **Fish hooks**, 30 to 35%, best; common, 50 to 55%; light kitchen **Fenders**, 5 inch assorted, 2 feet 6 inches to 3 feet 6 inches, black fronts, 28/ to 29/ per doz.; bright fronts, 31/6 to 34/; Manchester pattern kitchen Fenders, 5 feet 1 inch top, black front, 2 feet 9 inches to 3 feet 3 inches, 37/6 to 41/ per doz.; 3 feet 3 inches to 3 feet 9 inches, 42/6 to 46/. Cut wire **Fencing staples**, 0 to 6, 22/ to 24/ per cwt.

**Gridirons**, London pattern, fluted, 62½ to 65%; light ditto, 61½ to 67½%; hanging round bar, 50% to 55%; doublet, 37½ to 42½%; round bar /1½ per bar, 57½ to 62½%; best fluted bar, 5½ to 62½%; flat bar, 57½ to 62½%; common flat bar, 57½ to 62½%; common Gridirons, /1, /1½ and /2 per bar, 65 to 70%; **Goffering tongs**, two prongs, 5/6 to 6/6 per doz.; **Gimblets**, 10 to 15%.

**Lock furniture**, brass, 60½ to %62½; buffalo, 25 to 30%; china lock furniture, 37½ to 42½%; ebony lock furniture, 2¼-inch, Wilkes' spindles, 15/ to 18/ per dozen sets; sham ditto, 8/ to 9/ per dozen sets; **Norfolk latches**, common, best, 55 to 65% common **Suffolk latches**, 70 to 72½%; best Suffolk latches, 45 to 55%; tinned struck **ladle bowls**, 4-inch, 15/6 to 16/6; 4½-inch, 18/6 to 20/; 5-inch, 23/ to 25/ per gross net.

**Oddwork**, tinned and black, 15 to 20%, list; **Paris pointes**, best English, 15/6 to 16/; foreign, 18/ to 20/; **planes**, 25 to 30%; iron **axle pulleys**, 1¾ inch, 12/6 to 18/; brass face axle pulleys, 28/ to 40/ per gross; B. F. and wheel, 48/ to 60/ per gross; brass escutcheon **pins**, ⅜ inch to 16 W. G., 1/ to 1/2 per lb.; bright gimp pins, ⅜ to 19 W. G., /6 to /8 per lb.; black, /7 to /9; brass 1/6 to 1/8 per lb. Japanned cut **gimp pins**, ⅜ inch, /7 to /8 per lb.; tinned, /8 to /9 per lb.; cut clog or coffin pins, japanned, ⅜ inch, /5 to /6; tinned, /7 to /8; brass pin pointes, 1/4 to 1/6; **plate locks**, fine 40 to 50%; strong, 30 to 35%; Lancashire plate locks, 25 to 30%; pewter measures, 20 to 25%.

**Knitting pins**, iron, /4½ to /5 per lb.; steel knitting pins, 15 to 24 W.G., 1/ to 2/6 per lb.; brass knitting pins, 1/4 to 1/6 per lb.; **keys and banks**, 50 to 55%; extra strong plate, 30 to 32½%; extra strong Banbury, pin'd keys, 30 to 35%; brass shutter **knobs**, 52½ to 57½%; brass cupboard turns, 52½ to 57½%; brass drawer knobs, 52½ to 57½%; brass ash pan knobs, 52½ to 57½%; brass range knobs, 35 to 40%; **kettle ears**, 77½% to 80.

**Riddles**, 30 to 35%; **Rivets**, iron boot rivets, /3½ to /4 per lb. patent machine-made Rivets, 30 to 35%; wrought tinmen's Rivets, 50 to 55%; round or panhead boiler Rivets, ¼ inch, 21/ to 24/; ⅜ inch, 18/ to 19/; ½ inch, 17/ to 18/; ¾ inch, 16/ to 17/. Delivered in London or Liverpool; machine-made wire Rivets, ⅜ inch, 14/6 to 15/6 per cwt. **Rakes**, light garden Rakes 50 to 60%; light solid end Rakes, 47½ to 50%; bolstered teeth garden Rakes, 50%; solid end bolstered teeth garden Rakes, 40 to 45%.

**Spades and Shovels**, common, 52½/ to 55%; second, 35 to 40%; best 30 to 35%; best strong country Shovels; 25 to 30%; best hammered Spades and Shovels, 5 to 10%; **Ship Scrapers**, black steel blades, 45 to 50%; bright, 42½ to 47½%; cast-steel black, 42½ to 47½%; bright, 37½ to 42½%; best cast-steel black, 35 to 40%; bright, 30 to 35%; iron **Wood Screws**, 65%; brass wood Screws, 60 to 62½%; copper, 35 to 45%; Stove Screws, 50 to 57½%; dowel Screws, 60 to 65%; brass headlock Screws, 40 to 47%; gilt, silvered and plated head Screws, 40 to 45%; jute **Sash cord**, 52½ to 57½%; flax Sash-cord, 25 to 30%; best flax, 5 to 10%; super flax, 7½ to 12½%; extra super flax Sash-cord, 5 to 10%; patent steel ribbon **Sash-line**, 25 to 35%; copper **Sash-chain**, 52½ to 57½%; zinc Sash-chain, 47½ to 52½%; iron pre-

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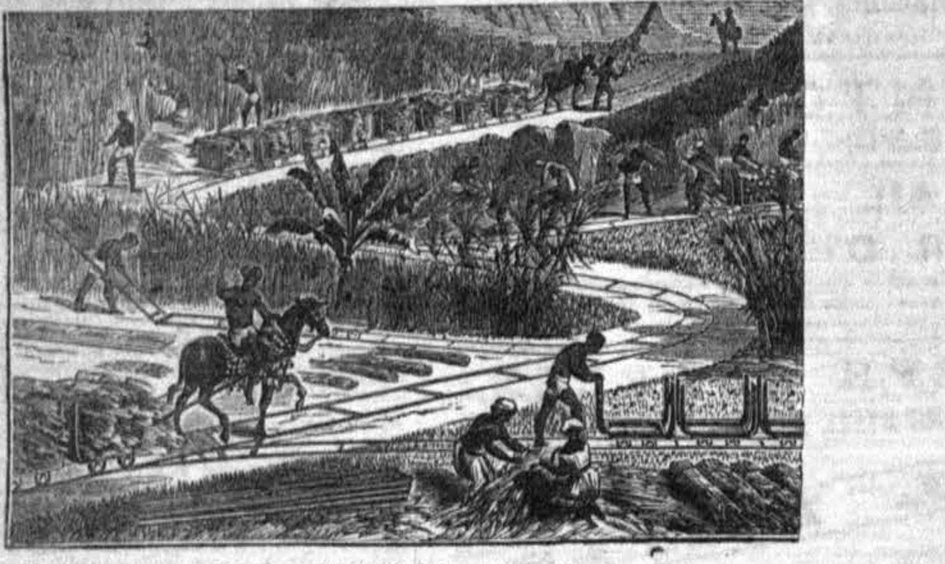

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pared, 40 to 45%; copper Sash-cord, 15 to 20%. **Sad irons**, common, 10/6 to 12 per cwt.; best japanned, 14/6 to 16/6; best best japanned, 18/ to 20/ per cwt.; **Shoe heels**, York, No. 1, 3/5 to 3/8; No. 2, 4/ to 4/3; No. 3, 8/ to 8/9 per gross net; Dundee hot turned, 5/9 to 6/3; bright-edge imperial or solid Scotch, 9/6 to 10/; bright York 61 B, 8/ to 8/6; bright solid, 6/6 to 7/; toe plates, 9/6 to 10/ per gross. **Stair rods**, turned ends, 75 to 80%; solid fancy ends, 60 to 65%; cased tube, 30 to 35%; patent solid ornamental, 35 to 40%. **Sofa Springs**, coppered, 8 by 6 inches, 25/ to 27/ per gross; 9 by 7 in. 21/6 to 23/6; 7 by 7 inches, 17/6 to 19/6 per gross; galvanised **Waterloo Scoops and hods**, 17/6 per doz.; japanned Waterloo scoops and hods, 16 inch. 15/ to 16/; japanned scoops and hods, light, 16 inch, 15 to 16/ per doz.; **Shutter bars**, common spring, broad and double, 75 to 77½%; Scotch iron drop, 77½ to 80%; brass drop, 70 to 72½%; brass drop and catch, 67½ to 70%; registered brass spring box shutter bars, 52½ to 67½%; double-handed brass spring box, 57½ to 65%; **Saddlers' tools**, 5 to 10%; **Stocks and Dies** for smiths' use, 35 to 40%; ditto for engineers, 10 to 20%; **Steel toys**, 10 to 30%.

**Traps**, bow spring, sham Dorset and real Dorset rabbit traps, 45 to 65%, list prices; common traps, 4 inch, 5/6 to 8/ per doz. net; run traps, 2½ inch, 4/ to 8/6 per doz.; bird traps, 3/9 to 4/ per doz.; wolf and other double flat spring, common bridge, 1/; axle bridge, 1/4 per lb., 40 to 45%; hawk or pole traps, 54 to 80%; wrought mole traps, japanned, 2/6 to 3/9; galvanised, 3/9 to 4/9. **Tin plates**, I C, 30/ to 32/. **Tinmen's machines and tools**, 5%; brass **Bell Tube**, ⅜ inch and upwards, 1/ to 1/1 per lb.; copper bell Tube, 1/2 to 1/4 per lb.; zinc bell Tube, 45 to 50% list; **Patent cased Tube**, 45 to 50%; cut to lengths, 40 to 45%; burnished and lacquered brass tube, 30 to 35%; polished and lacquered twisted brass tube, 30 to 35%; patent taper iron tube, 30 to 35%; patent cased taper iron tube, 30 to 35%; parallel iron brazed tube, 30 to 35%; twisted iron parallel tube, 30 to 35%; patent cased twisted iron parallel tube, 30 to 35%; iron **Gas Tubes**, 60 to 62½%; fittings, 62½ to 65%; iron **Water Tubes**, 50 to 52½%; fittings, 52½ to 55%; iron **Steam Tubes**, 45 to 47½%; fittings, 47½ to 50%; galvanised iron gas Tubes, 45 to 47½%; fittings, 47½ to 50%; lap-welded **Boiler Tubes**, 47½ to 50%, delivered in London, Liverpool or Glasgow; table catches, 36 to 40%; ditto, improved brass follow, 20 to 25%; wrought japanned **Tea kettles**, 50 to 60%; galvanised **Turnip skips**, 21 inches, light, 25/ to 26/ per doz.

**Vices**, common black, 32/ to 34/ per cwt.; common bright, 40/ to 42/ per cwt.; black staples vices, solid box black, 42 to 48/; bright, 41/ to 47/; solid box, black staple, with spherical washer, 40/ to 45/; bright 51/ to 55/.

**Washers**, light iron, 70%; heavy washers, 13 to 16 lb., W.G., 12/6 to 14/ per cwt.; ¼ inch thick, 2/ per cwt. extra; 5-16 inch, 3/; ⅜ inch 4/; shook bright washers, 3/ to 3/6 per cwt. extra; **Wall hooks**, 23/ to 25/ per cwt.; **Washing tubs**, galvansed oval, 22 inch, 29/ to 30/; 24 inch, 34/ to 35/; round, 22 inch, 38/ to 40/; **Water bowls**, hammered, list price, 52½ to 57½%; light seamed 9 inch, 8/ per dozen; light wired 9 inch, stamped, 11/ to 12/; **Wove wire** list price, iron, copper and brass, 45 to 50%; iron **Wire**, bright, 0 to 6, 13/ to 14/ per cwt.; galvanised, 17/ to 18/; fine galvanised iron wire, No. 23, 5/ to 5/3 per stone 14 lb.; annealed tinned wire No. 18, 3/10 to 4/ per stone 14 lb.; cut tinned bottling wire, No. 22, 4/8 to 5/3 per stone 14 lb.; weaving and binding wire, No. 23, 3/9 to 3/10 per stone 14 lb.; bright or annealed fine wire, 23, 5/4 to 5/6 per stone 14 lb. net; cast steel wire, 0 to 6, /9½ per lb.; 10 to 20%; metallic or horticultural wire, 6 to 14, /5½ to /6½ per lb; No. 15, 5¾ to /6; 16 to 20, /5½ to /6½; in 1 lb. rings, 1¼ inch diameter, /½ per lb. extra; prepared bright **fencing Wire**, 0 to 6, 13/6 to 14/ per cwt.; annealed drawn fencing wire, 0 to 6, 10/6 to 11/; annealed drawn galvanised, 0 to 6, 16/6 to 17/. Bright or annealed steel, 0 to 6, round or oval 15/9 to 19/6 per cwt.; black rolled, 1 to 4, 10/6 to 11/6 per cwt.; galvanised rolled, 1 to 4, 13/9 to 14/6 per cwt.,

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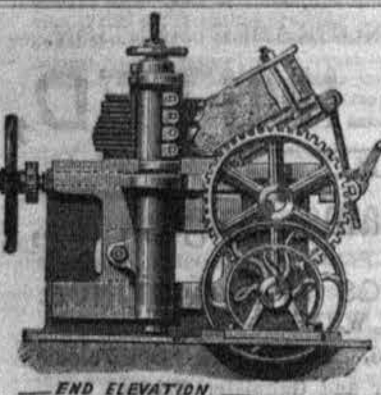

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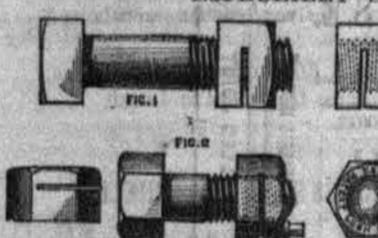

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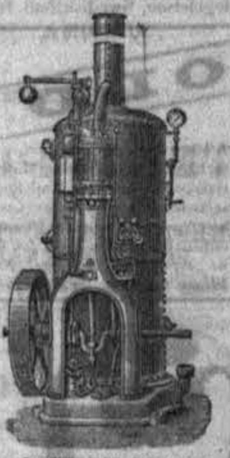

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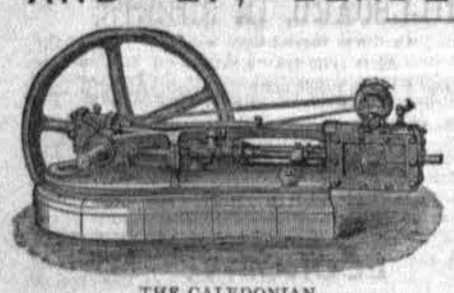

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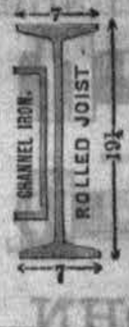

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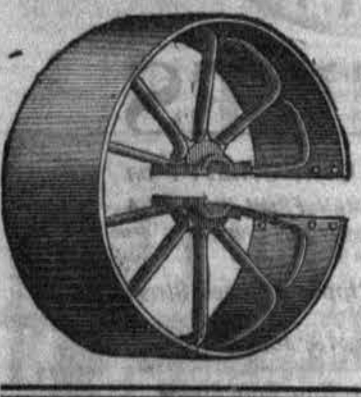

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Simple, Light, Elastic, Strong, Durable & Cheap (Mackie's Patent).
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GOODS SUPPLIED THROUGH THE TRADE.

## AGRICULTURAL ENGINEERS' ASSOCIATION.

THE following communication has been addressed by this Association to the President of the Commissioners of the Melbourne International Exhibition:—

7, Westminster Chambers, London, S.W.,
January 14th, 1880.

Sir,—In view of your approaching International Exhibition, the members of the Agricultural Engineers' Association of England have had under their consideration the question of the duties levied upon agricultural machinery imported into the Colony of Victoria.

As President of the Association, and in accordance with a resolution passed at a recent general meeting of the members, will you permit me to direct your attention to the views of the members upon the tariff question?

In the first place they submit that whatever may be the policy of a country in respect of duties on machinery in general, implements and machines used in the production of food for the people, should be admitted free of duty. The introduction and use of new and improved implements must always contribute to increased production of the soil, and are therefore indirectly a gain to the national wealth. An imposition of duties, which checks the introduction of valuable machines from other countries, retards the extension of improved cultivation and the development of the resources of the land. This view, the members think, applies with more than ordinary force to a country such as your Colony, where the agricultural interest is relatively of such overwhelming importance.

The relations between England and America may be well referred to. In England the market has been entirely open. American manufacturers, availing themselves of the advantage thus offered, have found a very ready sale for some of their productions used in agriculture. It is acknowledged that a severe competition has thus been created, more especially in harvesting machinery, but this has had the very healthy effect of stimulating the exertions of our own manufacturers. At the same time the English makers, having, year after year, had the most perfect specimens of American machinery brought under their notice, have been enabled to compete with American makers in the other markets of the world upon far more equal terms than would otherwise have been the case.

Looking at the other side of the question, much of the agricultural machinery in use in America does not compare favourably with that of English manufacture, and the reason for this may be fairly assigned to the fact that, owing to the American import duties being so high, the introduction of English implements and machines has been impossible. Observant Americans are beginning to acknowledge the loss which American agriculture has thereby sustained. To say nothing of the manifest superiority of English implements for tillage, threshing, and other barn machinery take the steam plough. In no other country is there a greater necessity, and for no other country is the steam plough more adapted, than for America. Owing, however, to the imposition of a duty of 40 per cent. on steam cultivating machinery, cultivation by steam power is almost unknown in America, whilst in Great Britain, with less than one-twentieth of the area, thousands of steam ploughs are in use. Had the ports in the United States been open, I am convinced that years ago, not only would the steam plough have been in common use, but that large manufactories for their production would have been brought into existence in the United States.

As the result of personal observation in America, and from other sources of information, I am persuaded that far greater progress would have been made in America in the manufacture of many branches of agricultural machinery under free trade than has taken place under the protective system.

This question of protective duties cannot be separated from the policy of International Exhibitions. The absence or otherwise of such duties must necessarily exercise a corresponding influence upon the permanent advantages which flow from the holding of these Exhibitions. An International Exhibition implies the idea that the primary object is to afford the opportunity of judging in what productions the various countries excel, and to encourage a subsequent interchange of commotidies between the several countries represented. Any impediment imposed by a State to free exchange between one country and another would seem out of harmony with an exhibition in which the whole world is invited to participate.

This view was forced upon the attention of the members of this association, when invited to the Philadelphia Exhibition. So strong was the feeling upon the subject of American tariff that the English manufacturers of agricultural steam engines and machinery, in a body, determined to abstain from exhibiting, and this upon the ground stated in the following resolution passed unanimously at a meeting of the Association:—"That looking to the prohibitory duties, from 30 to 40 per cent., imposed by the United States upon agricultural machinery, the Association recommends its members to hold aloof from the Philadelphia Exhibition, considering the imposition of prohibitory duties to be out of harmony with the objects of International Exhibitions."

Whilst the members of this Association regret the pro-

FOR MINING, ENGINEERING AND GENERAL MECHANICAL PURPOSES
LEATHER INDIA-RUBBER GUTTA-PERCHA
GEO. ANGUS & Co NEWCASTLE-ON-TYNE AND LIVERPOOL.

tective tariff in the Colony of Victoria, and whilst they feel that such a tariff is not in accordance with the spirit of International Exhibitions, their course in regard to your Exhibition will not be one of abstention, because they hope and believe that in the present case the Exhibition will help towards the adoption of a more liberal policy on the part of the Colony.

In this country the public spirit of the Australian Colonies in going to the trouble and expense of International Exhibitions is fully recognised, and the general desire is that they may promote the growth and prosperity of that portion of the British empire in which Englishmen feel so deep an interest.—I have the honour to be your obedient servant,

JAMES HOWARD, President.

The President of the Commissioners,
Melbourne International Exhibition.

## HARRINGTON, HORAN AND CO.'S COPPER REPORT.

CHILI Copper Charters for the first half of this month were 1500 tons fine, consisting of 1200 tons bars and 300 tons regulus, all for England.

We have to record an advance of £4 per ton in the value of Chili bars during the past fortnight, and a very large business indeed has been done at the enhanced rates. Upwards of 2000 tons Australian copper sold on private terms, and large purchases of English copper have been made for export to India and America. There is, however, a less active demand to-day, and quotations for Chili copper are somewhat easier.

In furnace material the transactions comprise 700 tons Chili regulus at 14s. 9d.; 835 tons at 15s.; 770 tons Bolivian ore at 14s. 3d.; 300 tons Mexican ore at 14s. 3d.; 200 tons at 15s.; 600 tons New Quebrada ore at 14s. 6d; 50 tons Chili ore at 15s.; 900 tons Cape ore at 14s. 9d; 600 tons at 15s.; 200 tons at 15s. 3d.; 200 tons Spanish precipitate at 14s. 3d.; 170 tons English at 15s. 6d. per unit; and at the Swansea public sale by tender on the 27th ult., 1255 tons ore average produce 11½ per cent. realised 13s. 9½ per unit.

Import of Chili copper during the past fortnight, 650 tons fine, against 356 tons fine same time last year. Delivery of Chili copper during the past fortnight, 1455 tons fine, against 1476 tons fine same time last year.

Quotations are to-day:—Chili bars, £73 0s. to £74 0s.; Chili ingots, £80; Chili ore and regulus, 15s. to 15s. 6d.; Coro Coro Barilla, 16s.

Quotations were 31st January, 1879:—Chili bars, £56 0s. to £56 10s.; Chili ingots, £63; Chili ore and regulus, 10s. 6d. to 11s. 0d.; Coro Coro Barilla, 12s. 3d.

Quotations were 31st January, 1878:—Chili Bars, £66 to £67; Chili ingots, £72; Chili ore and regulus, 12s. 9d. to 13s. 3d.; Coro Coro Barilla, 14s. 6d.

Quotations were 31st January, 1877:—Chili bars, £73 10s. to £75 10s.; Chili ingots, £81; Chili ore and regulus, 14s. 9d. to 15s.; Coro Coro Barilla, 16s. 0d.

Arrival here during the fortnight of West Coast S. A. produce:—*Pot si* from Valparaiso, &c., 450 bars; 200 ingots.

Stocks of copper (Chilian and Bolivian) in the first and second hands, likely to be available, we estimate at:—Liverpool, 25,928 bars; 50 ingots. Swansea, 600 regulus; 4258 bars. Total 600 regulus; 30,186 bars; 50 ingots; representing about 30,506 tons fine copper, against 31,311 tons 15th ult.; 27,000, 31st January, 1879; 16,867, 31st January 1878; and 14,191 tons, 31st January, 1877.

Stock of copper contained in other foreign ore and Spanish precipitate, 533 tons fine. Stock of Chili copper in Havre, 3298 tons fine against 4816 tons, 15th January, 1879. Stock of Coro Coro Barilla in Havre, 285 tons fine against 1960 tons 15th January, 1879. Stock of Chili copper afloat and chartered for to date 15,500 tons fine against 11,400 tons 15th January, 1879. Stock of foreign copper in London, chiefly Australian, 5130 tons fine against 6032 tons 15th January, 1879.

TIN.—Market has been very active at fully £5 per ton advance since our last. Quotations to-day are £98 10s. for Straits and Australian; £104 for British and £94 for Peruvian. The Banca sale in Holland went at 59¾ florins, equal to about £100 10s. here.

LEAD.—Market firm at £19 5s. for ordinary shipping brands and £18 15s. for Spanish without silver.

SPELTER.—Market steady at £21 for ordinary Silesian brands.

QUICKSILVER.—Market steady at £7 5s. to £7 10s. per bottle for Spanish.

BAR SILVER.—$52\frac{7}{16}$d. per oz. standard.

BANK RATE OF DISCOUNT.—3 per cent.

Liverpool, 30th January, 1880.

JOSEPH WRIGHT & Co.
LIMITED.
NEPTUNE FORGE, CHAIN, ANCHOR & ENGINE WORKS,
TIPTON. STAFFORDSHIRE.
SOLE MAKERS OF THE CELEBRATED
CRANE CHAIN.
SPECIAL TRADE MARK. A1. BEST. J.W&Co BEST. A1.
CHAIN CABLES
THEY HAVE NEVER BEEN SURPASSED FOR STRENGTH, UNIFORMITY OR DURABILITY, AND ARE MADE BY SPECIAL WORKMEN, FROM IRON OF A SPECIAL QUALITY, PREPARED EXPRESSLY FOR THIS COMPANY ONLY.
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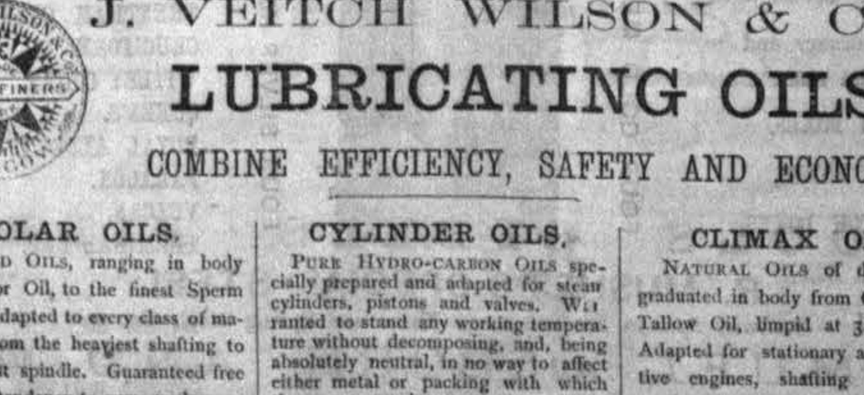
GREENOCK AGENT: Mr. JOHN CAMPBELL, Jun., 56, Rue End Street.

STEAM LAUNCH "FLORENCE." 25 Feet Long. PRICE £140. *Always in stock or progress.*



MILLER & TUPP, Steam Launch Builders, Creek Engine Works, Middle Mall, Hammersmith, London.
SINGLE-HANDED STEAM LAUNCHES 20 FT. LONG FROM £80.—LAUNCH ENGINES AND BOILERS.
*Illustrated descriptive Price List of Steam Launches from 20 ft. to 60 ft. long, free on application.*

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LUBRICATING OILS
COMBINE EFFICIENCY, SAFETY AND ECONOMY.
POLAR OILS. REFINED OILS, ranging in body from Castor Oil, to the finest Sperm Oil, and adapted to every class of machinery, from the heaviest shafting to the lightest spindle. Guaranteed free from any tendency to gum or clog.
CYLINDER OILS. PURE HYDRO-CARBON OILS specially prepared and adapted for steam cylinders, pistons and valves. Warranted to stand any working temperature without decomposing, and, being absolutely neutral, in no way to affect either metal or packing with which they may come into contact.
CLIMAX OILS. NATURAL OILS of dark Colour, graduated in body from Castor Oil to Tallow Oil, limpid at 32 deg. Fah. Adapted for stationary and locomotive engines, shafting and heavy machinery, screwing, boring, &c.
SAMPLES, PRICES, AND OTHER PARTICULARS ON APPLICATION.
OFFICE: 5, ST. VINCENT PLACE, } GLASGOW.
WORKS: 258, DOBBIE'S LOAN,

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(SIEMENS' PROCESS),

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MANUFACTURERS OF

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# LUBRICATING OILS

ADAPTED FOR

*Railways, Steamships, Engines of all Classes, Looms, and Spindles.*

SPECIAL OILS FOR IRON WORKS AND COLLIERIES.

Samples and Prices on Application.

46, QUEEN VICTORIA STREET, LONDON, E.C.

Works: CAROLINE PARK, EDINBURGH.

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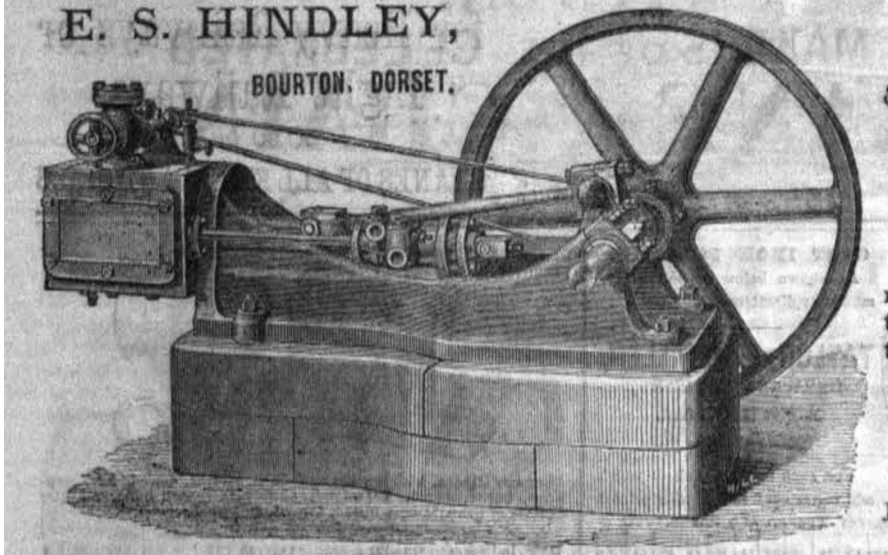
BOURTON, DORSET.



*VERTICAL AND HORIZONTAL STEAM ENGINES, SAW BENCHES, &c.*

**Catalogues, Testimonials, on application to the above address, or to the following Agents**

LONDON:
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PARIS:
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homson's Screw Pulley Block.

MEDAL

In the Supreme Court of Scotland, on 22nd December, 1876, and again in the House of Lords, on 10th July, 1877, judgment was pronounced in favour of THOMSON'S PATENT TUBE EXPANDER, and Dudgeon was found liable in costs.

COMPEGNIE.

Thomson's Patent Winch, Block or Hoist, will raise a load ten times quicker than his Patent Screw Block, where light lifts are required, say 5, 10, 15, or 20 cwt.
The Suspended Lever Weighing Machine is now largely used in all countries.

Thomson's Patent Winch Block.

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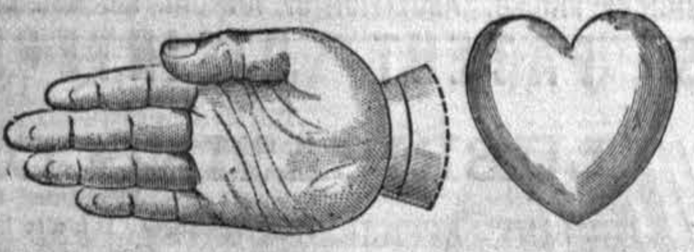
CORPORATE MARK.



Granted according to Act of Parliament, 1777 by the Cutlers' Company, Sheffield.

# TOOLS, STEELS, FILES,

R. MUSHET'S SPECIAL STEEL.

Railway Springs, Steel Castings, Shear and Spring Steel, &c., &c

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CLYDE STEEL AND IRON WORKS, SHEFFIELD.

LONDON: 16, PHILPOT LANE, E.C.; BOSTON (U.S.): 10, OLIVER STREET;
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## R. S. NEWALL & Co.,

*SOLE PATENTEES OF UNTWISTED WIRE ROPE,*

Beg to call attention to their superior made Iron and Steel WIRE Ropes, for Colliery and Railway purposes; also for Capstans, Guide Ropes, Suspension Bridges, &c.

*Ships' rigging supplied and fitted by experienced workmen to order,*
Pulleys made expressly for their Ropes. Patent Springs for ditto.
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## S. B. WHITFIELD,

Manufacturer of

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GLADSTONE WORKS.
WATERY LANE, BIRMINGHAM.

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Send for Illustrated Price List of

# BLAKE'S

SELF-ACTING

# HYDRAULIC RAMS

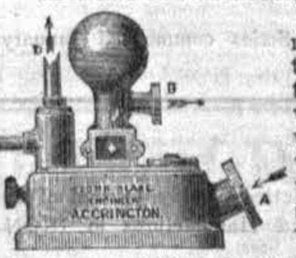
*For Raising Water for the Supply of Villages, Irrigation, Railway Stations, Mansions, Fountains, Farms.*

No cost for Motive Power, which is obtained from the Stream of Water passing through the Rams.

**WILL FORCE TO A HEIGHT OF 1500 FEET.**

Made in sizes to raise from 300 to 100,000 gallons per day.

NO OILING OR PACKING REQUIRED.



**This Ram will raise a part of the same water that works it, or will raise pure water from a well whilst it is worked by a stream of impure water.**

TESTIMONIALS.

FROM CAPTAIN TOWNSHEND, WINEHAM, FEB. 10, 1877.

"In answer to your enquiry, I am glad to say the Hydraulic Ram you sent me in November, 1875, is working exceedingly well, and gives no trouble. It will work when quite immersed, as it has been several times during the floods this winter, forcing up water through a delivery pipe 900 yards long at the rate of 80,000 gallons per day, although you only promised 50,000."

FROM W. SCARTH, ESQ., AGENT TO HIS GRACE THE DUKE OF CLEVELAND.

"Raby Castle, Darlington, July 16th, 1878.

"The Hydraulic Ram you supplied to His Grace the Duke of Cleveland in 1875 is a complete success. It worked for more than two years without once stopping, and throws more water than promised."

FROM JOHN TAYLOR, ESQ., THE ROCKS, BATH, AUG. 22, 1878.

"The Self-Acting Hydraulic Ram you fixed here in March of last year continues to work well. It has only the same quantity of water and fall to work it as the waterwheel and pump which I used previously to force to a height of 294 feet, and yet the ram sends up more than double the quantity of water that the wheel did to the same height."

**JOHN BLAKE, Engineer,**

ACCRINGTON,

LANCASHIRE.

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JOSEPH GILLOTT'S
STEEL PENS.

Sold by all Dealers throughout the World.

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## GAUNTLETT'S

Patent Pyrometer or Heat Gauge.

Recent improvements have rendered this Gauge extremely sensitive and durable. It is now made to register to 1500 deg. Fahrenheit. It is applied to Ovens, Heating Stoves, Boiler Flues, Heated Air, Hot Liquid Steam, Gases, &c. Testimonials on application.

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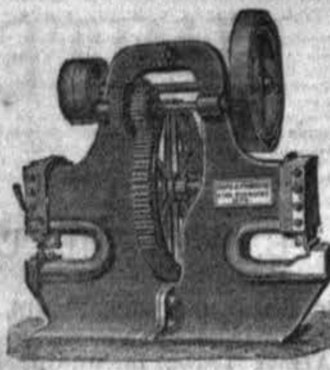
COFFIN FURNITURE
FOR THE WORLD'S MARKETS.



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The Circulation of this Paper will compare favourably with that of any other Journal of its class.

## IRON

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## IRON.

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## IRON.

Advertisements for this Paper must be sent in not Later than 6 p.m. on Thursday.

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(Late MARSHALL and WYLIE),

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MANUFACTURERS OF

## LAP-WELDED STEEL AND IRON BOILER TUBES,

*For Marine and Stationary Boilers, Locomotive and Portable Engines, &c.,*

Supply the principal Engineers and Shipbuilders on the Clyde, and have a large Home and Foreign connection.

**Locomotive Iron Tubes with Copper Ends.**

BRANCH OFFICES.—LONDON: 9, LONDON STREET, FENCHURCH STREET, E.C.
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## RANSOMES & RAPIER, ENGINEERS,

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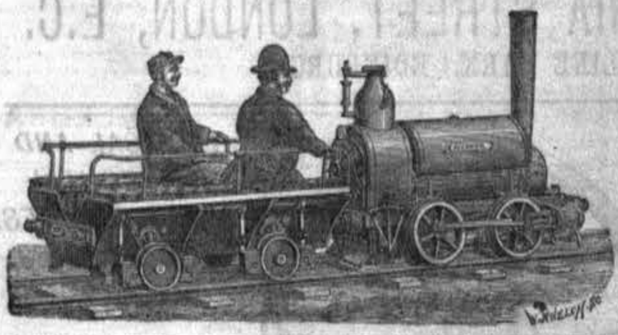

**Makers of all kinds of Machinery and plant for Heavy Railways or Light Railways.**

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**CAST IRON PULLEYS.**

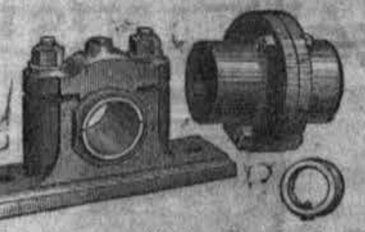
As shown below or in halves, made any diameter or width.

**TAYLOR & CHALLEN,**
DERWENT FOUNDRY,
BIRMINGHAM.

For each extra 1 inch in width add 10 per cent. to following prices:

Leading Sizes and Prices, Turned and Bored.

| Diameter in inches ... ... | 6 | 8 | 10 | 12 | 15 | 18 | 21 | 24 | 28 | 32 | 36 | 42 | 48 | 54 | 60 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Width, ditto ... | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 5 | 5 | 5 | 6 | 6 |
| Price, Split, shillings ... | 8 | 9 | 10 | 11 | 14 | 17 | 20 | 25 | 32 | 38 | 46 | 55 | 66 | 95 | 110 |
| Do. Plain do.... | 5 | 6 | 7 | 8 | 10 | 13 | 16 | 20 | 25 | 30 | 38 | 45 | 55 | 80 | 90 |



Plummer Blocks, with brasses and bolts, planed, bored, &c. Couplings, bored, faced, keywayed, and with turned bolts. Loose Collars of wrought iron bored, turned, and steel screws.

STOCK, SIZES, and PRICES, delivered here.

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| COUPLINGS ....................pair | 7/ | 8/ | 10/ | 13/ | 17/ | 22 | 28/ | 35/ |
| LOOSE COLLARS.............each | 2/2 | 2/6 | 13 | 3/6 | 4/ | 4/6 | 5/ | 6/ |
| SHAFTING, sup. qual. foot ...... | 1/3 | 1/7 | 2/1 | 2/6 | 3/3 | 4/ | 4/9 | 5/8 |

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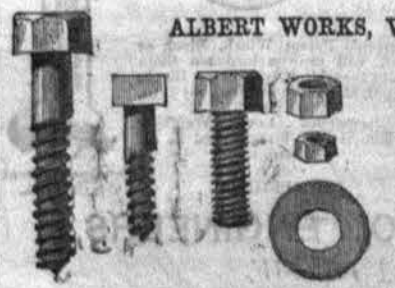
## ALBERT IRON COMPANY,

**ALBERT WORKS, WHIFFLET, COATBRIDGE, NEAR GLASGOW.**



Manufacturers of all kinds of machine and hand-made bolts, nuts, rivets, spikes, washers, wood-screws, &c. Contractors for iron-work. General smiths.

**PRICES ON APPLICATION.**

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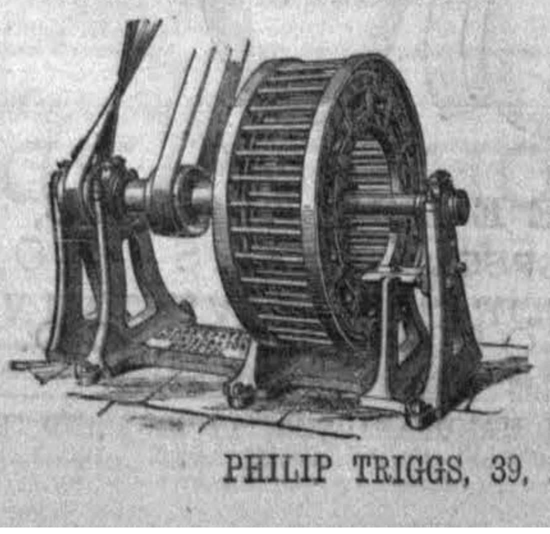
Awarded Bronze Medal, Paris Universal Exhibition, 1878.

**REVISION OF PRICES. ABOLITION OF ANNUAL LICENSE CHARGE.**

## CARR'S PATENT DISINTEGRATOR.



**This Machine effectually pulverises by the combined influences of percussion and of centrifugal force, Iron, Zinc, and other Ores, Asphalte, Artificial Manures, Phosphates, Fire Clay and many other substances. It is also largely in use for the pulverisation of coal for the manufacture of Coke, Patent Fuel, &c.; and is very effective for mixing Sugar.**

These Machines are capable of reducing to a fine granular powder from 50 to 200 tons per day (according to size) of any unfibrous material. Machines made to order from 18 inches diameter, to suit special requirements of purchasers; these small machines being specially adapted to the requirements of Chemical Manufacturers for Mixing and other purposes.

*A Descriptive Pamphlet will be sent free on application to the Managing Trustee of the Estate of the late Patentee.*

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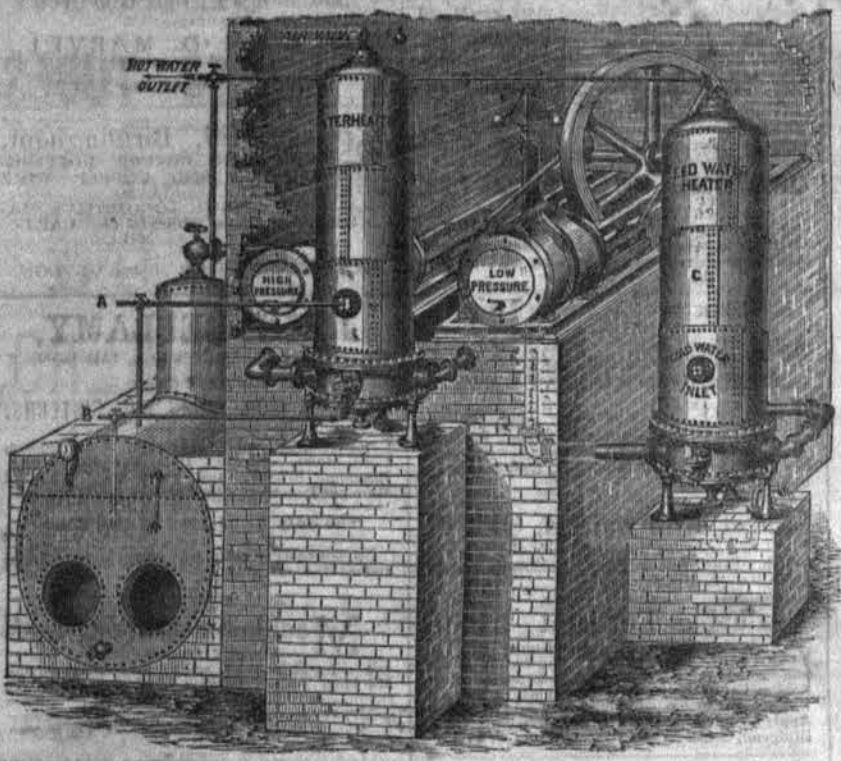

Neptune Forge, Engine and Boiler Works,

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And at 147, QUEEN VICTORIA STREET, LONDON, E.C.,
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## UNIVERSAL EXPANDING BRASS TUBULAR HEATER,

AS APPLIED TO HIGH-PRESSURE, CONDENSING AND

## COMPOUND ENGINES
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The great success which has attended the introduction of these Celebrated Heaters to High Pressure has led to their being applied to Condensing Engines also, and as Interheaters for Compound Engines—Stationary and Marine; and from actual experience J. W. and Co. have now reliable information as to the precise amount of Saving in Boiler Mending and Coal which can be realised by the judicious use of Exhaust steam from High Pressure, Condensing or Compound Engines with these justly

## CELEBRATED BERRYMAN HEATERS.

The Interheater shown in the above sketch is fixed at any convenient distance from the Cylinders in or outside the Engine-room. The Exhaust steam from the High Pressure Cylinder is passed through the inside of the Solid-drawn Bent Brass Tubes in the Interheater, and thence into the Steam Chest of the Low Pressure Cylinders.

N.B.—The application of these Heaters to Compound Engines largely increases the effective power, especially where Engines are under their work, and they can be added to any existing plant.

**AS INTERHEATERS & FEEDWATER HEATERS,**
56 ARE NOW IN USE IN GREAT BRITAIN AND IRELAND EFFECTING VERY GREAT SAVING. ILLUSTRATED PRICES AND TESTIMONIALS on application to the Works.

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General Store for Wharf, &c.

The system adopted by F. M. and Co., in the Construction of their Galvanised Corrugated Iron Buildings combines many advantages which no other form of building can offer. At a minimum cost they provide every required accommodation, while the construction secures great strength and durability, together with protection against fire. Illustrated Catalogues and Estimates sent on application when Purchasers should supply full particulars of requirements.

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| *London* | 1862 |
| *Paris (class 53)* | 1867 |
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| *Naples* | 1871 |
| *Trieste* | 1871 |
| *Moscow (Gold)* | 1872 |
| *Moscow (Silver)* | 1872 |
| *Brussels (do.)* | 1876 |

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POOLEY'S PATENT
SELF-INDICATING
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TURNTABLE
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*For all Commercial, Manufacturing, Railway and Mining Uses.*
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| *Manchester and Liverpool* | 1867 |
| *Royal* | 1869 |
| *Royal* | 1870 |
| *Manchester and Liverpool* | 1871 |
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Chatham District.—Commissariat Office, the Barracks, Chatham.

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Army Contract Department,
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2nd February, 1880.

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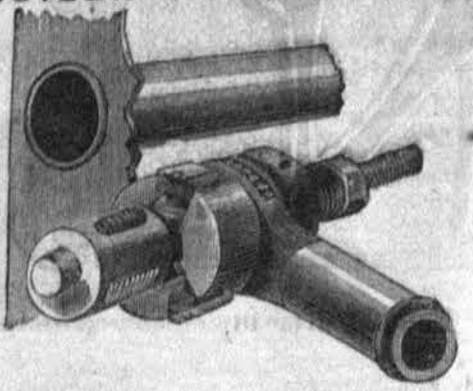

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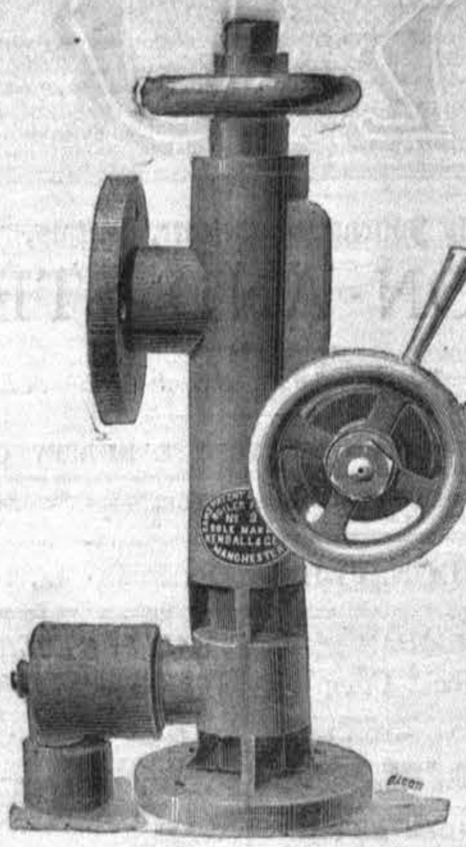

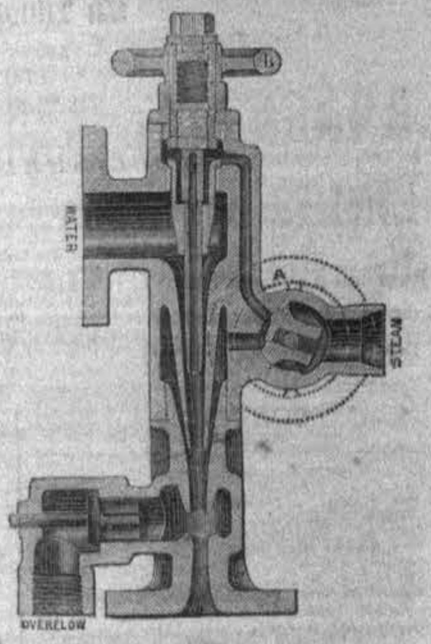

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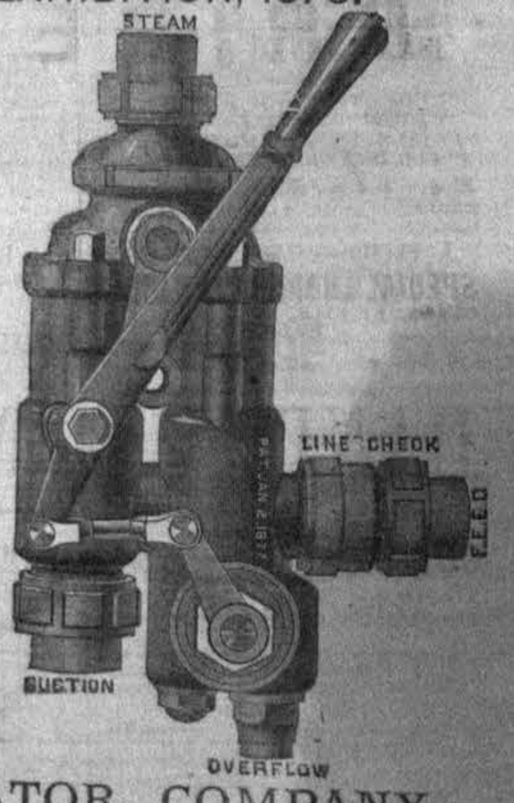

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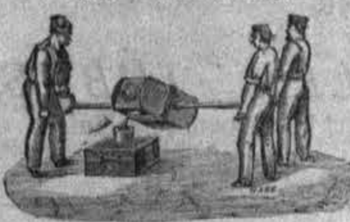
Fig. 1. Handling by Hand.



Furnace of 65 lbs. capacity, handled by two or three men.

These Furnaces can be placed in any desired position in a Foundry or Shop; brought to wherever required; and very easily handled.

They yield the following "practical" results, attainable only by their **Special Oscillating Capacity**, thus obviating the necessity of taking the Crucible out of the Furnace. Hence **Economy in Fuel, in Hand labour, in Crucibles**, and in Time. No waste whatever; and Immunity from Accidents.

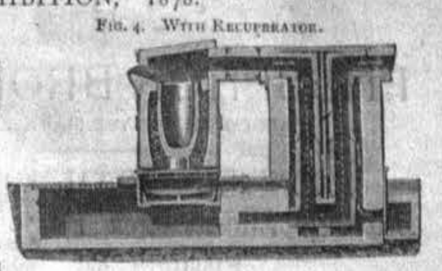
Cheap Crucibles can be used instead of Plumbago, thus giving an advantage of 300 per cent. in Crucibles alone.

The following results have been obtained by using these Furnaces:—

| BRASS. | | BRONZE. | |
|---|---|---|---|
| No. of Castings ... ... ... .. | 10 | No. of Castings ... ... ... ... | 12 |
| Time ... ... ... ... | 8 hours | Time... ... ... ... ... | 9 hours |
| Quantity Cast ... ... ... ... | 5·23 cwt. | Quantity Cast ... ... ... ... | 12 cwt. |
| Coke used ... ... ... ... ... | 22 per cent. | Coke used ... ... ... ... ... | 22 per cent. |
| Capacity of Furnace ... ... ... | 90 lbs. | Capacity of Furnace ... ... ... | 110 lbs. |

**N.B.—The economy in working these Furnaces becomes more apparent with each successive casting, owing to the Patent Oscillating Arrangement. This is one of the special advantages of the system.**

Fig. 4. With Recuperator.



Furnace with recuperator from 65 lbs. to 350 lbs., and greater capacity with forced.

### ILLUSTRATIONS SHOWING MODE OF WORKING THE FURNACE, &c.

### TESTIMONIALS.

From Mirrlees, Tate and Watson, Glasgow. Glasgow, Nov. 7th, 1879.

In reply to your inquiry of 4th inst., we are glad to say that the two Brass Furnaces supplied to us by M. Piat, are working satisfactorily, and we have no objections to your referring intending purchasers to us,

(Signed) Mirrlees, Tate and Watson.

To Monsieur Piat. Paris, Nov. 7th, 1879.

Replying to your inquiry, we are glad to say we are entirely satisfied with your Portable and Oscillating Furnace, as with its aid we are able to cast 100 kilos. of steel (larocque), consuming only 80 kilos of coke; also, we find its handling to be very convenient.

(Signed) Rullier, Maucet and Co., Founders of Larocque Steel.

From M. Edouard Bourdon, Manufacturer of the Bourdon Gauges, &c.

To M. Piat. Paris, Sept. 18th, 1879.

Having thoroughly tested your Portable Oscillating Furnaces in casting of every description, I found them very economical, and in every respect satisfactory.

### RECENT TESTIMONIAL.

Result of working a 220 lbs. PIAT'S PATENT PORTABLE AND OSCILLATING FURNACE, *with Natural Draught and Clay Crucibles*, at the Works of Crozet and Co., Loire, France, on January 12th, 1880.

| Number. | Weight of Bronze charged. | | | Coke consumed. | | | Furnace lit. | | Time of casting. | | Duration of charge. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cwt. | qrs. | lbs. | cwt. | qrs. | lbs | h. | m. | h. | m. | h. | m. |
| 1 | 1 | 3 | 4 | 0 | 2 | 18 | 6 | 0 | 8 | 20 | 2 | 20 |
| 2 | 1 | 3 | 4 | 0 | 1 | 14 | 8 | 25 | 10 | 0 | 1 | 35 |
| 3 | 1 | 3 | 7 | 0 | 1 | 18 | 10 | 5 | 11 | 5 | 1 | 0 |
| 4 | 1 | 3 | 4 | 0 | 0 | 26 | 11 | 10 | 12 | 0 | 0 | 50 |
| 5 | 1 | 2 | 12 | 0 | 0 | 20 | 12 | 5 | 1 | 10 | 1 | 5 |
| 6 | 1 | 3 | 4 | 0 | 0 | 24 | 1 | 15 | 2 | 15 | 1 | 0 |
| 7 | 1 | 2 | 14 | 0 | 1 | 0 | 2 | 20 | 3 | 15 | 0 | 55 |
| 8 | 0 | 1 | 27 | 0 | 0 | 11 | 3 | 20 | 3 | 50 | 0 | 30 |

**Average time over each of the 8 Castings, 1h. 2m. Average percentage of Coke 42 lbs.**

Le Chambon Feugerolles (Loire), January 13th, 1880.

To M. Piat, Paris.

We have the pleasure of handing you a statement of the working of your Furnace of 100 kilos. (220 lbs.) under the direction of Mr. Charlier. The results obtained are highly satisfactory, and we have pleasure in recording them.

(Signed) Crozet and Co.

### OPINIONS OF THE PRESS.

(From *Engineering*, of Nov. 21, 1879).—Piat's Oscillating Furnace.

"A new form of portable crucible furnace has lately been introduced with great succes in France, by M. Piat, of Paris. The advantages claimed are a marked economy of fuel and labour, a greater durability of the crucibles, and increased rapidity of melting. As we have already said, this form of furnace is being largely introduced in France, and the experience obtained with it appears to bear out the various claims made for it."

(From *Iron*, May 25, 1878).—Improved Melting Furnaces.

"We saw at the Paris Exposition, and later in use in the foundry of the exhibitor and patentee, M. A. Piat, of Paris, an arrangement designed to effect economy and give safety; being an oscillating and portable furnace. To effect still greater economy in fuel in the larger sizes, a recuperator is employed to heat the blast by means of the escaping gases of combustion. If natural draft be employed, the vent must be connected with the chimney by a suitable pipe. The employment of such devices permits of running the metal very hot; the last piece being run as hot as the first—a special point in steel casting. The heats take less time, and are in greater number; thus, 30 kilos. of bronze are run, say every 35 minutes; every 40 minutes for 60 kilos.; and every 50 minutes for a 120 kilo. furnace. The work of pouring is very much easier and surer; clay crucibles last longer; plumbago crucibles last 60 to 70 heats; the fuel bill is decreased, as but 18 to 25 per cent. of coke is used for bronze, and 80 per cent. for steel; there is less dross, and the workmen are less fatigued and less frequently burned. These advantages seem to entitle the system of oscillating and portable furnaces to receive a fair share of investigation and trial.

See also articles in *Iron*, May 10 and Nov. 28, 1879.

Extract from the *Constructeur* of Dec., 1878 (Moniteur Special des Industries du Fer).

"These furnaces permit of the casting of the metal in its highest degree of temperature, which is a great consideration for certain metals, such as steel, &c. They are also very handy for large castings, as they avoid the employment of reverberatory furnaces, while they are equally good for small castings, &c."

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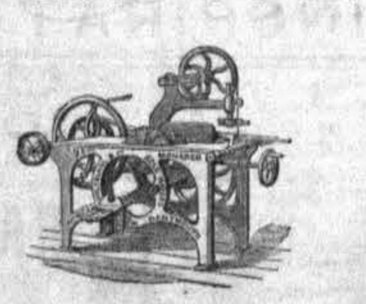

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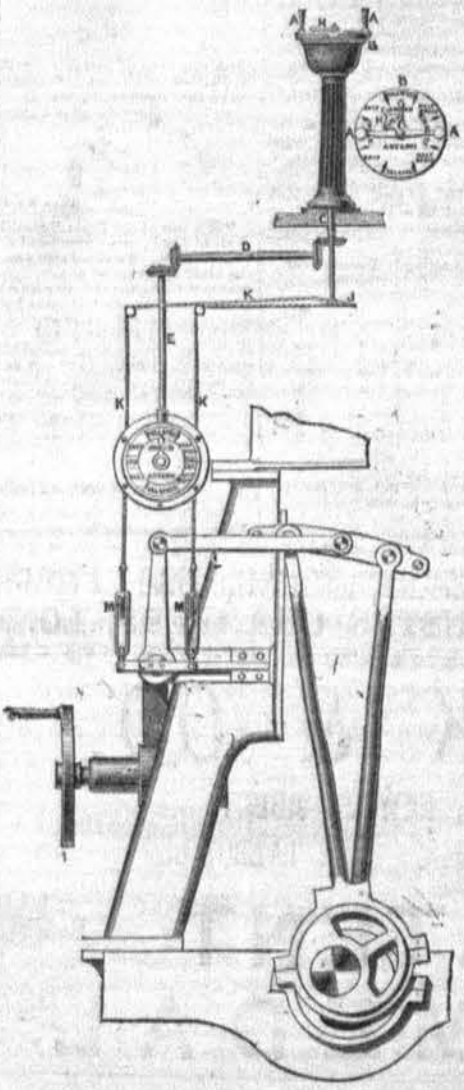

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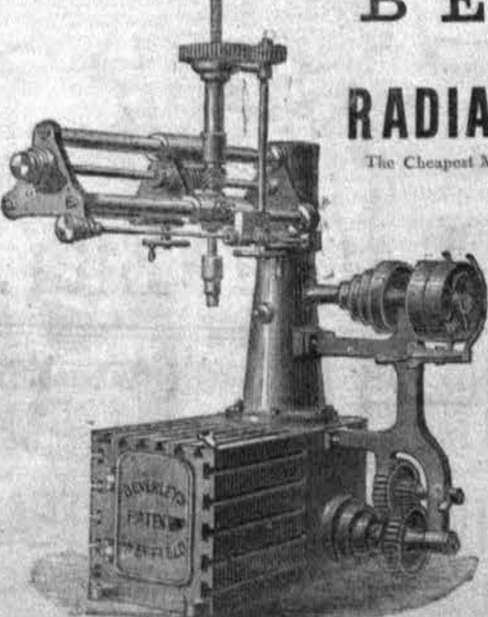

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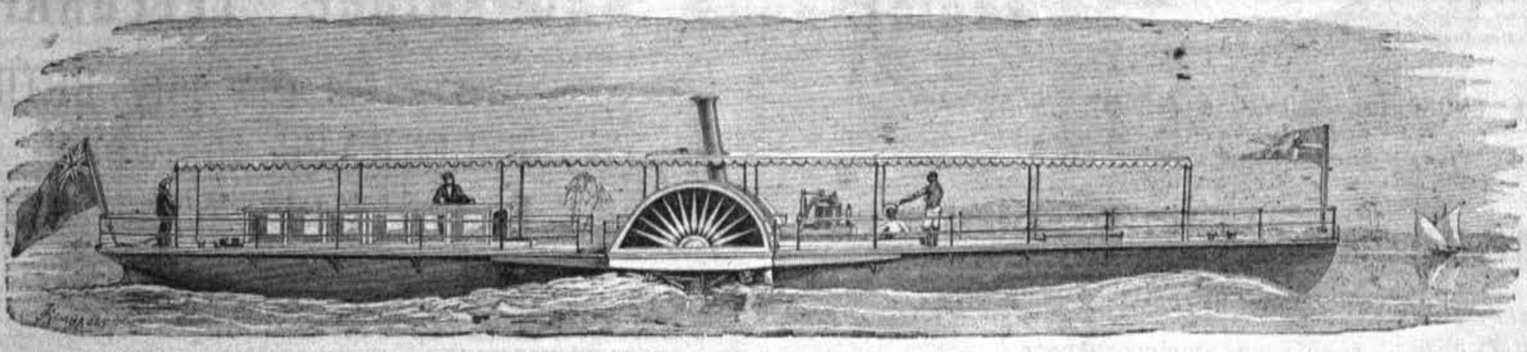

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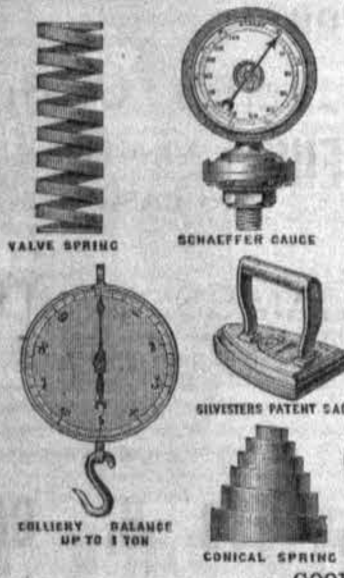

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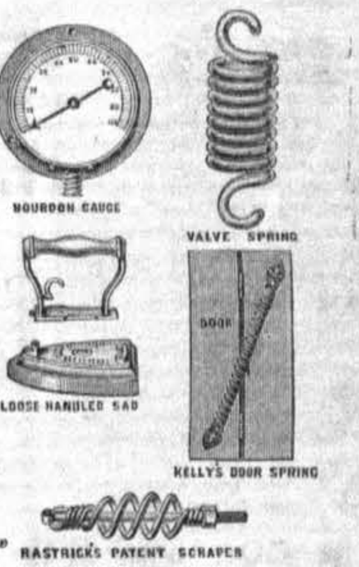

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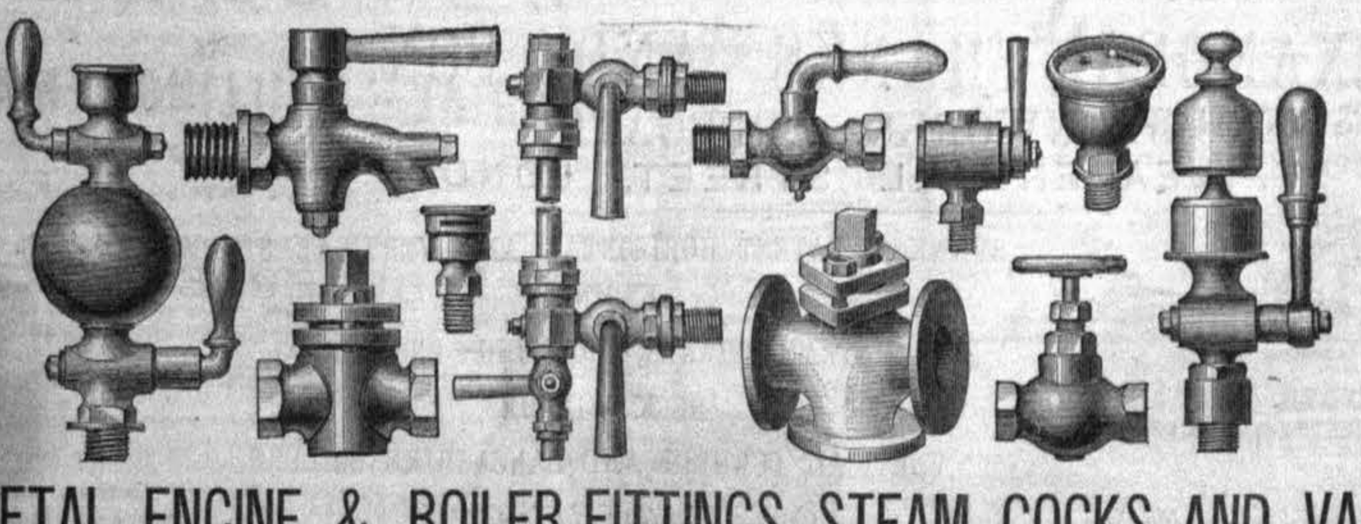

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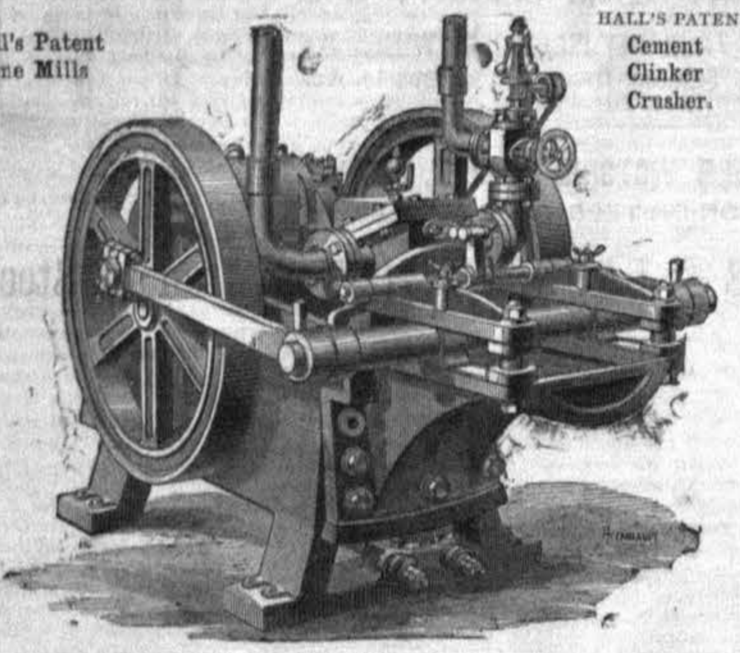
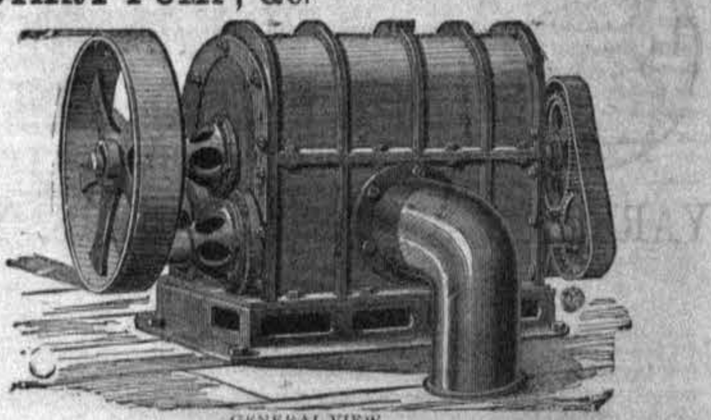
Clinker
Crusher.



ENGINE AND MACHINE COMBINED.

## BAKER'S ROTARY PRESSURE BLOWER GAS EXHAUSTER and VENTILATOR, BAKER'S ROTARY PUMP, &c.



GENERAL VIEW.

**This Blower is adapted for Cupolas, Smiths' Fires, Ore Hearths, Slag Hearths, Refineries, &c., &c., also for Ventilating Coal and other Mines, Ships, Buildings, Railway Tunnels, Drying Rooms, and generally for elevating Grain, Timber, Sugar, &c.**

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Fewness of parts—Less pulsation than any of its class—Capability of running direct from an Engine—Not being affected internally by wearing of gears—Requiring no lubrication internally, and no dubbing to make it temporarily tight—Exhausting as well as blowing—Non-injury from dust—Steady running, without jerking belts—Unchangeability in power from damp—Blowing hot and cold equally well—Small power required for amount of air discharged—And entire absence of friction internally.

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IF PURCHASERS ARE UNABLE TO OBTAIN THE PRACTICAL RESULTS CLAIMED FOR THIS DRILL, J. S. & M. ARE WILLING TO UNDERTAKE CONTRACTS AT SAME PRICE PER FATHOM DRIVEN AS PAID FOR HAND LABOUR, AND, FAILING TO OBTAIN RAPID ADVANCE, AND TO PROVE THE ADVANTAGES OF THE MACHINE, AGREE TO TAKE IT BACK.

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STEAM CRANES, HOISTING ENGINES,
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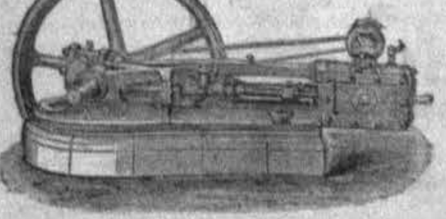
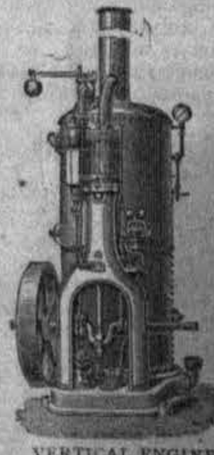


THE CALEDONIAN.



VERTICAL ENGINE AND BOILER.

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WHEATLEY KIRK, PRICE AND GOULTY, ENGINEERS, ALBERT SQUARE, MANCHESTER,
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IRON.

*LONDON, FRIDAY, FEBRUARY* 13, 1880.

## COMBUSTION IN BOILER FURNACES.

THE use of fuel in the ordinary boiler furnace for the evaporation of water to produce motive-power is now so universal that the possible uneconomical conditions of combustion are seldom considered as they deserve to be. It is a great incentive to improvement and invention, publicly to uphold a clear comparison between what is, and what ought to be. We would wish, in that sense, for the benefit of our readers, whether users of steam power only or manufacturers of steam appliances, to discuss analytically the present conditions of steam generation and use. The first broad point of comparison to which we would draw attention, is that of the true chemical value of fuel in combustion, and the actual value realised from it in practice. By experimental research, and in scientific parlance, it is known that 1 lb. of carbon, in combustion with oxygen, will develop about 8000 units of heat Centigrade; that is, it will serve to raise 14,000 lb. of water through one degree of Fahrenheit. Here is a distinct and valuable fact to start with. Coal, we know, is not pure carbon; but so far from detracting from its value, the volatile hydro-carbon gases have a much greater heat-developing power by combustion than carbon alone. We shall therefore be justified in taking the above 14,000 units of heat Fahrenheit as the possible productive heating effect of 1 lb. of coal. We will next proceed to show that only a very inconsiderable portion of this heat-giving power of coal is utilised in practice.

It is well known that the average consumption of coal under a boiler reaches, with small vertical boilers, as much as 7 lb. or 8 lb. per indicated horse-power per hour in the engine, and that the consumption has been reduced as low as 2½ lb. per hour per indicated horse-power in large and economical condensing engines and boilers. We will take this latter most favourable condition for estimating the work usually realised from coal as fuel. One indicated horse-power per hour is 33,000 × 60 = 1,980,000 foot-pounds; and this, produced at an expenditure of 2½ lb. of coal, would be 792,000 foot-pounds per pound of coal. Referring now to the circumstance that one pound of coal develops about 14,000 units of heat Fahrenheit—and remembering that it is a well-established fact that one unit of heat Fahrenheit is strictly equivalent to 772 foot-pounds, the total strict equivalent of work obtained from one pound of coal in combustion should be 14,000 × 772 = 10,808,000 foot-pounds. We thus have a comparison between 792,000 foot-pounds, which is about the most that has been obtained in the practice, per pound of coal, from the best class of condensing engines in regular work, and 10,808,000 foot-pounds as the theoretical value of one pound of coal in combustion. That is, the usual best class of condensing engine develops about $\frac{1}{13}$th of the theoretical value of the fuel burnt, and the average commercial engine does not develop more than about $\frac{1}{40}$th of the above ascertained theoretical value of the fuel. Seeing that it is considered a very fair engine indeed which utilises 8 per cent. of the theoretical value of the fuel, the question arises as to what has become of the wasted 92 per cent. Can we apportion, with any exactness, the stages of the evaporation and utilisation of steam in which the various proportions of this loss arise? Are we paying sufficiently close attention to the production and utilisation of steam power to be realising as much as we can? Is the enormous loss we experience an essential part of the process adopted for evaporation and utilisation? And might we, by a fresh departure in power generation, save enormously on the present wasteful system in use?

We will first consider the ordinary boiler furnace and the usual conditions of combustion therein. There is no doubt that very few furnaces effect anything like perfect combustion, so we shall be justified in allowing for an average loss under this head of 20 per cent. This loss, of course, shows in smoke, soot, cinders and unconsumed ash. This source of loss may be combated by a proper attention to draught and a suitable admission of air sufficient to maintain proper combustion and yet not to be in excess. This proper proportion of air may be easily calculated per pound of coal consumed thus:—The chemical reaction of combustion is represented by the combination of carbon with oxygen to produce carbonic acid, without paying attention to the smaller reactions of the hydro-carbons in combustion. From the formula $CO_2$, we see that the proportion of oxygen by weight for every pound of carbon consumed will be as 32 to 12. Therefore for every pound of carbon consumed in the grate at least 2⅔ lb. of oxygen must pass through the grate for theoretical combustion. But the oxygen forms only about 1-5th of atmospheric air, therefore 13⅓ lb. of air must pass the grate for every pound of carbon theoretically consumed. This amount, to allow for the hydro-carbons, and to give a small excess of oxygen to ensure perfect combustion, should be increased practically to 17 or 18 lb. of air per pound of coal consumed, or to about 200 cubic feet. The amount of air actually passed through the average furnace is more nearly 24 lb., or 300 cubic feet, than 200, as perfect combustion with a limited volume of air can only be attained by the use of a fairly thick and even fire and a sharp draught. Now a great waste is occasioned by the use of such large volumes of atmospheric air in a cold condition, which are eventually discharged up the chimney at a temperature frequently as much as 500° Fahr. If we take the ordinary average of 24 lb. of air passing through the furnace per pound of coal consumed, and if we assume that this weight of gas, plus the weight of the coal—that is, altogether 25 lb., in the shape of nitrogen, carbonic acid, water vapour, &c.—is delivered up the chimney at a temperature of 500° Fahr., it altogether represents about 2900 units of heat thrown away. The number of units of heat developed by theoretical combustion are, 14,400, which, less 20 per cent. for what is not generated at all, leaves nett 11,520 units developed, showing a waste up the chimney of 2900, or over 25 per cent. This is, however, 25 per cent. of the proportion of heat utilised, which we estimate is only 80 per cent. of the whole. This loss of 25 per cent. of 80 per cent. will become 20 per cent. of the whole, which added to 20 per cent. not developed in the furnace, makes up a total of 40 per cent. of the whole theoretical heat which never enters the boiler at all.

Much of this waste is absolutely unavoidable, inasmuch as in the first place, the temperature of steam at 50 lb. above atmosphere is nearly 300° Fahr., it is absolutely necessary that the issuing gases should at any rate be nearly 400° Fahr. In the next place, a good draught is an essential condition for good combustion, and for sufficient evaporation from the trade size of boiler per horse-power. But a quick draught usually means a high temperature of the escaping gases. So here we apparently have to choose between two evils. We would suggest as a means of reducing both these evils, that the boiler flues should be constructed with a reducing area right down to the fire-grate. Thus a moderate temperature of exit, and consequently a moderate draught at the chimney shaft, and a constantly increasing draught, may be obtained up to the fire-grate, where it may be thus given a sufficient velocity to produce adequate combustion.

## OUR TRADE SUMMARY.

THE comparative quietness in the pig-iron trade, noticeable for a fortnight byegone, still continues, although in several districts there are indications of a rise; but at the same time the improvement appears to be spreading to other departments of the trade, some of which the revival has up to the present time but slightly influenced. There were considerable fluctuations in the Glasgow warrant market during the past week; but on the whole a good business has been done. Prices closed on Wednesday at 68s. 3d. to 68s. 9d. cash, and a farther rise is expected. Rates for makers' iron are firmer than they were the preceding week, and several good sales have been effected, while production in expectation of future demands is going on briskly. The manufactured iron trade is also active. Prices are firm, and additions are being made to the means of production. The shipbuilding branch continues very busy, as also the locomotive business, and the engineers and founders are fairly well employed. The Middlesborough pig-iron market on Tuesday was firm, with a tendency to a rise. Forge iron maintains its exceptionally high price, two more furnaces have been blown in, and six others are expected to be lighted by the end of the month. The finished-iron trade continues very busy, more orders being in hand than the manufacturers can execute. The same observation applies to the tube works, and the nut and bolt works have also had a fair share of employment. The engineers are worst off, but their prospects are likewise brightening. In the Durham district all branches of the iron industry are fully employed, and there also new works are being brought into operation. The tide of improvement flows as strongly and fully as ever in the north-west, and it is expected that as the season advances industrial activity will increase. As it is at present, makers of pig-iron have considerable difficulty in meeting their engagements; but they are pushing forward the construction of new furnaces. Inquiries are so active, both on home and foreign account, that the high current prices will probably be sustained for a good while to come. The steel trade of the district is expanding, with a brisk demand from every side, and the finished-iron makers are overwhelmed with orders. There was considerable slackness in the Manchester market on Tuesday, although there is still a fair inquiry for shipment, with considerable orders coming in now and then. Notwithstanding the lull, however, prices remain very firm. The engineers and machinists are busier, which is a good symptom, and rather more is doing in the foundry trade. In West Yorkshire the improvement is becoming more general, and there is an increased railway demand, both for rails and rolling stock. From the Barnsley district a continued large output of pig-iron is reported, with an average production of Bessemer steel rails, &c. In merchant and other kinds of manufactured iron there is more doing. In the Sheffield district, while the iron trade maintains its former activity, prices have fallen a little in some of the inferior qualities; the activity in the iron industries has also given an impetus to the general trade of the locality, and there is every sign that the improvement will be permanent. The plate, hoop and sheet trade is extraordinarily brisk at enhanced nates. The news from South Wales is of the most cheering description, indicating a most gratifying contrast to the condition of the country only a very few years ago. The special trades of Sheffield are in an improving condition, business increasing steadily in extent and value. It appears to be otherwise with the local industries in Birmingham, which are reported in an unsatisfactory state. Although both in that district and in that of which Wolverhampton is the centre, the heavy iron industries have nothing to complain of, in neither is there much to encourage in the position of the hardware trades, although South Staffordshire is in a better position in that respect than its neighbour. There is not much that is favourable to report of the coal trade. The manufacture of coke is extending, and there is some increase in the demand for manufacturing coal, but this is balanced by the falling off in that for household qualities.

## THE CATTLE AND IMPLEMENT SHOW AT PARIS.

THIS annual show, organised by the Minister of Agriculture and Commerce, is arranged to take place before Shrove Tuesday, just as the Smithfield show happens a short time before Christmas day, and has therefore fallen rather early this year. On the 1st inst. the President of the Republic spent a considerable time in examining the various machines, of which there are 100 entries more than last year, and which are arranged as usual on that portion of the Champs Elysées between the Palais de l'Industrie and the Seine. Some of the leading French manufacturers, MM. Albaret et Cie, Rantigny, Oise; Gautreau, Dourdan, Seine-et-Oise; Bajac-Delahaye, Liancourt, Oise, the largest maker of ploughs in France; and Pécard, Nevers, Nièvre, were represented by imposing displays. Several French houses exhibited the English goods for which they are agents, as, for instance, MM. Muller et Roux, those of Messrs. Tangye Brothers, and M. Pinot-Maniglier those of Messrs. Picksley, Sims and Co. Many English and American firms have branch establishments in France—generally Paris—which gives them the right to exhibit in their own name; of this number are Messrs. Aveling and Porter, Smyth and Son (seed drills), Osborne, Aultman, and Waite-Burnell, Huggins and Co. M. Th. Pilter, the original and still the most extensive introducer of English agricultural implements into France, had, as usual, a goodly collection of machines, including some novelties which will be referred to below. Mr. Clark, of Paris, showed Messrs. Legrand and Sutcliffe's Abysinian tube wells, and English wood-working machinery was represented by Messrs. Reynolds and Co., and Messrs. Powis and Co., both of whom have branches in Paris. Mr. J. Cumming, of Orleans, is making all the same parts of his implements interchangeable, and is also putting down automatic machinery for the production of steel and wrought iron parts for the machines of other English makers, in lieu of the probable increase in the tariff for the introduction into France of finished engine and machine work. The steady improvement, however, in all classes of French agricultural machinery, combined with the already high and anticipated prohibitive duties, should warn English manufacturers that they must not rely upon France for any considerable market in the future.

### TRAMWAYS AND ROLLING STOCK.

Light tramways were laid down with points and crossings, turntables, and weighbridges, and also provided with Lilliputian rolling stock of great variety, by M. L. Paupier, of Paris, whose "universal carrier" has been described and illustrated in IRON,* by MM. Chauvin et Marin-Darbel, Paris, who has brought out a capital luggage truck with three wheels, that in front swivelling; and by M. Decauville, of Petit Bourg, whose system has been introduced into England by Messrs. John Fowler & Co., of Leeds. M. Decauville exhibited a new turntable without rails for light loads, which can be worked by one man more easily than if he has to get the rails of the turntable in line with those of the tramway.

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* Vol xiii., p. 804.

# IMPLEMENTS AT THE PARIS CATTLE SHOW.

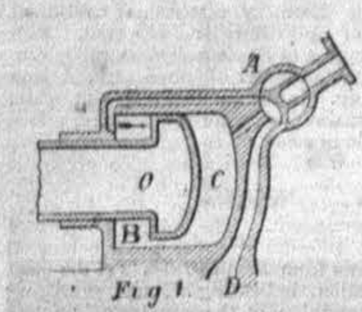

Fig 1.

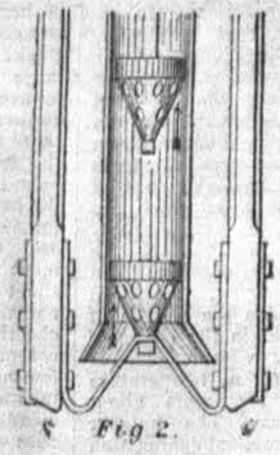

Fig 2.

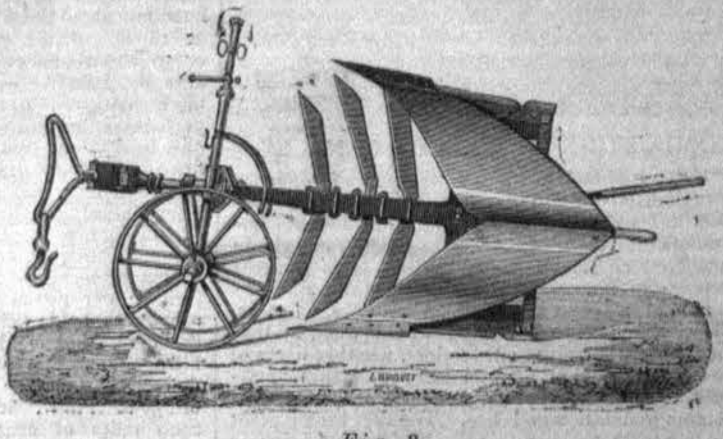

Fig. 3.

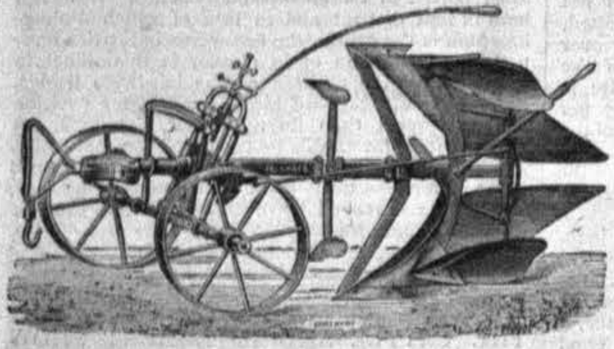

Fig. 4.

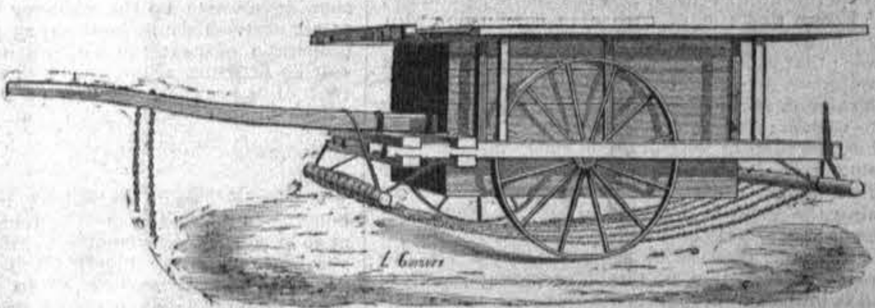

Fig. 5.

Last year he showed two locomotives constructed, by way of experiment, especially for his small lines, and has now fixed upon that of the Société Marcinelle et Couillet, of Belgium, which has been fitted with a large firebox for burning wood or briquettes, an American chimney with spark-arrester, ash-pan and damper, and fuel racks over the side tanks. A combined truck-elevator and tipper was shown in action for supplying sugar-houses and distilleries with what is usually called beetroot, but what is really mangold-wurtzell.

## Motive Power.

Nearly all the engines exhibited were of the portable type, either on the English or locomotive system, or on the Continental model, in which there is no firebox proper, but one central flue surrounded by tubes for the return of the flame or gases, which necessitates the chimney being placed over the firebars instead of at the front end. The boilers of many of the portables exhibited consist of two shells connected at right angles like the letter T laid on its side ⊢, the shorter portion serving for firebox below and steam-dome above. M. Pécard showed Hornsby's latest arrangement of portable engine besides others of his own make, both on the English and Continental model. Messrs. F. W. Reynolds and Co. sent their patent portable provided with a steam jet up the chimney for creating a draught, which keeps the tubes clear without the necessity of brushes, and also a feed-heater, which raises the water to boiling point before entering the boiler. Messrs. Waite-Burnell, Huggins and Co., showed for the first time their two horse-power portable engine mounted on wood-wheels, as being lighter than iron, and having the hind-axle cranked so as to pass under the firebox, thus giving great steadiness. This diminutive motor is fitted with two safety valves, one to lock up steam-jet and water-heater, as well as all the mountings usually provided for a large engine. In M. Gautreau's portable, the cylinder and valve-chest are both steam-jacketed; and steam is admitted to the cylinder direct from the boiler, the exhaust circulating through the saddle for heating the feed-water. The safety valves are mounted on the valve-chest. The pressure is taken off the back of the valve, and the expansion is made variable by the governor on Farcot's system. MM. Fichot, Frères, Toulon-sur-Aroux, showed working both stationary and portable engines with oscillating cylinders as illustrated last year, and also two sizes of portables fitted with a new arrangement of fixed cylinder shown in the accompaying engravings at fig. 1. The plug valve (A), caused to make a partial turn in its seat at each revolution, admits steam first on the annular surface, (B) of the piston during the forward stroke, then causes it to act at lower pressure on the circular, and (C) during the backward stroke, and then exhausts it by the passage (D) leading to the chimney. Such is the economy of fuel effected by this arrangement, that, with a pressure of 50 lb. per square inch, only 5½ lb. of coal is burnt per horse-power. Messrs. J. R. Whitley and Co., London and Paris, showed Hindley's three horse-power combined vertical engine and boiler, with the usual bright parts nickel-plated, driving a fixed threshing-machine by M. C. Limare. M. Chaudré, Paris, exhibited his dial water-gauges, in which a float in the boiler acts, by means of a crank, rod and sector, on a needle pointing to "excess," "level," or "deficiency."

M. Pécard found room on his stand for Sanderson's *anémone*, a windmill consisting of two half-discs of sheet iron, about 4 feet in diameter, set at right angles to each other and mounted on a horizontal shaft. It is stated that this motor will develop a force of 1-5th horse-power when the wind is blowing at the rate of 23 feet a second, 2-5ths at 33 feet and 4-5ths at 49 feet.

The vertical form of horse-gear, more generally used on the Continent than the ordinary horizontal type, was originally devised by M. J. Pinet in 1854, and since that time more than ten thousand have been delivered. His successors, La Société des Usines d'Abilly, showed one of these horse-gears in conjunction with a simple threshing-machine. The advantages are that instead of a lay-shaft, which ought to be cased in, there is a half-crossed belt, well over the heads of men and animals, transmitting the power from the horizontal pulley of the horse-gear to a vertical pulley on the thresher; the absence of bevel-gear prevents loss of power from inordinate friction; the appliance is easily dismounted and re-erected, there being no cotter and only five bolts fixing the whole, while it also yields a speed of 125 revolutions a minute. The horse-gear of the Société Française de Matériel Agricole, Paris, Bordeaux, and Creil, has a bevel wheel on the main vertical shaft, transmiting motion to the second horizontal shaft, which, with spur-wheel and pinion, transmits it to the third, and this to the fourth, a belt from the vertical pulley driving the thresher direct. MM. Albaret et Cie have brought out a new horizontal horse-gear, for four horses or oxen, or four pairs of either, with an arrangement for securing a given speed whether the faster or the slower animals are employed. The whole is mounted on a solid truck running on four wheels, and the animals are harnessed to four poles which form continuations of the sides of a square wooden frame. The frame has a strap-brake inside, which passes round a large horizontal wheel, and causes it to turn at the same time unless too great resistance is encountered, when the frame and brake pass round without turning the wheel. The rim of the latter has cog teeth both on its upper and under surface, which gear with conical spur pinions, one above and one below, keyed on to an inclined shaft, having a bevel-wheel in the middle capable of being slid along the shaft so as to gear with a larger or a smaller spur-pinion keyed on the horizontal lay-shaft, provided with a universal joint for coupling to any rod.

## Pumps.

M. Noël, of Paris, may be congratulated on being the object of the sincerest form of flattery, for imitations of his pumps, which are now well known and appreciated in England as well as France, were to be seen at several stands. Besides the pumps exhibited at Kilburn last year, M. Noël showed one on wheels, combined with reservoir, and also a tank on wheels, with two single-acting barrels, capable of throwing a jet 80 feet, for serving as a fire-engine, as well as for lifting and forcing. The air-vessel between the two vertical barrels acts as a fulcrum for the swing-lever. M. A. Bouilliant, Paris, who has a blast-furnace and foundries at Boussard in Eure-et-Loire, has brought out a pump on an entirely new principle, shown by the vertical section at fig. 2. The conical pistons, formed of cupped leathers, yield at their circumference, so as to allow the passage of matters suspended in the water. They also act as valves, no others being provided. The upper piston is connected to the rod in the usual manner, and the lower one to two rods outside the barrel articulated to a point in the lever as far removed from the fulcrum as that is from the joint of the main rod. The effect of this arrangement is to bring the two pistons towards each other during the down-stroke of the lever, and separate them at the up-stroke. Owing to the impetus given to the water, the delivery is greater than the theoretical; and this is, of course, the more marked the greater the speed, as the friction is slight. This pump requires but little power to work, one man being able, with a 4-inch barrel, to raise 44 gallons a minute to a height of 11 feet 6 inches. Besides a pump of the diameter named above, a model was shown in action, which readily allowed seeds to pass the pistons.

M. E. Farcot, Paris, showed his new centrifugal pump, with which he has been experimenting since the Applied Science Exhibition. He curves the floats the reverse way to that usually adopted, and provides a kind of fly-wheel of water, which causes the latter to leave the orifice without shocks and in a stream of constant velocity.

MM. Moret et Broquet, Paris, showed, in action, two interesting types of pumps, designed and manufactured by them. The Pinion rotary pump, the chamber of which has a pair of pinions working into one another, draws from 3 feet and throws a vertical jet of from 60 feet to 100 feet high, giving a continual flow without an air-vessel. In a barrel-pump of short stroke, for raising liquid manures, &c., the barrels are arranged alongside a chamber, and the vacuum produced alternately in the former fills and empties the chamber without the water having time to enter the barrels at all, thus avoiding a considerable amount of friction. A single thumbscrew secures the two covers, the removal of which lays open all four valves. These are of india-rubber, without any metal in the middle, which causes them to wear oval. This pump will throw 2640 gallons an hour to a height of 50 feet. M. David, Orleans, showed the Chapelet chain pump made by him. The buckets are of indiarubber, mounted on malleable cast-iron washers and links. A ratchet-wheel and pawl are provided for preventing slip.

# PAINTER'S HYDROSTATIC JOINT.

(*For description see page* 112.)

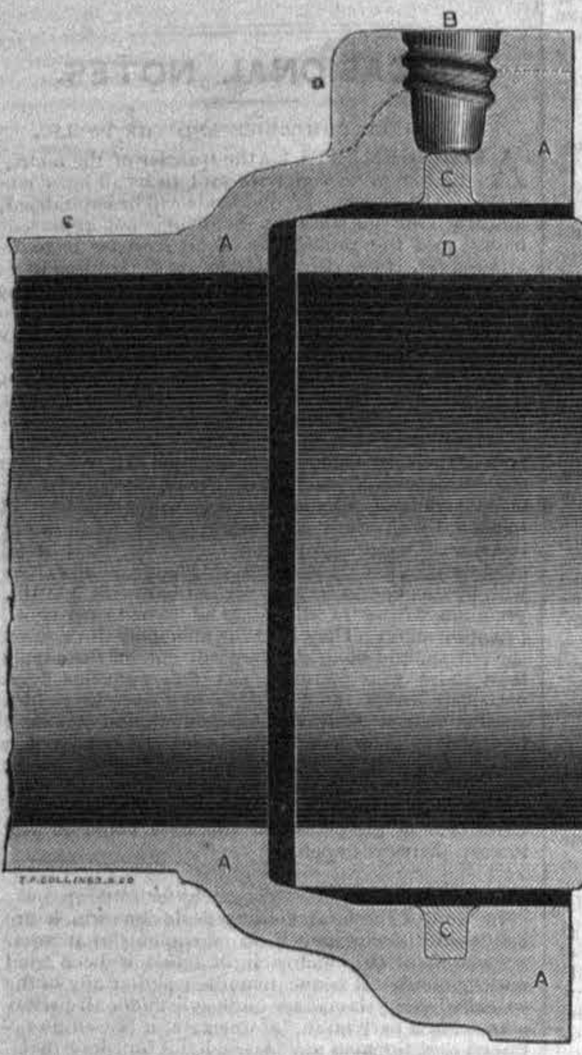

FIG. 1.

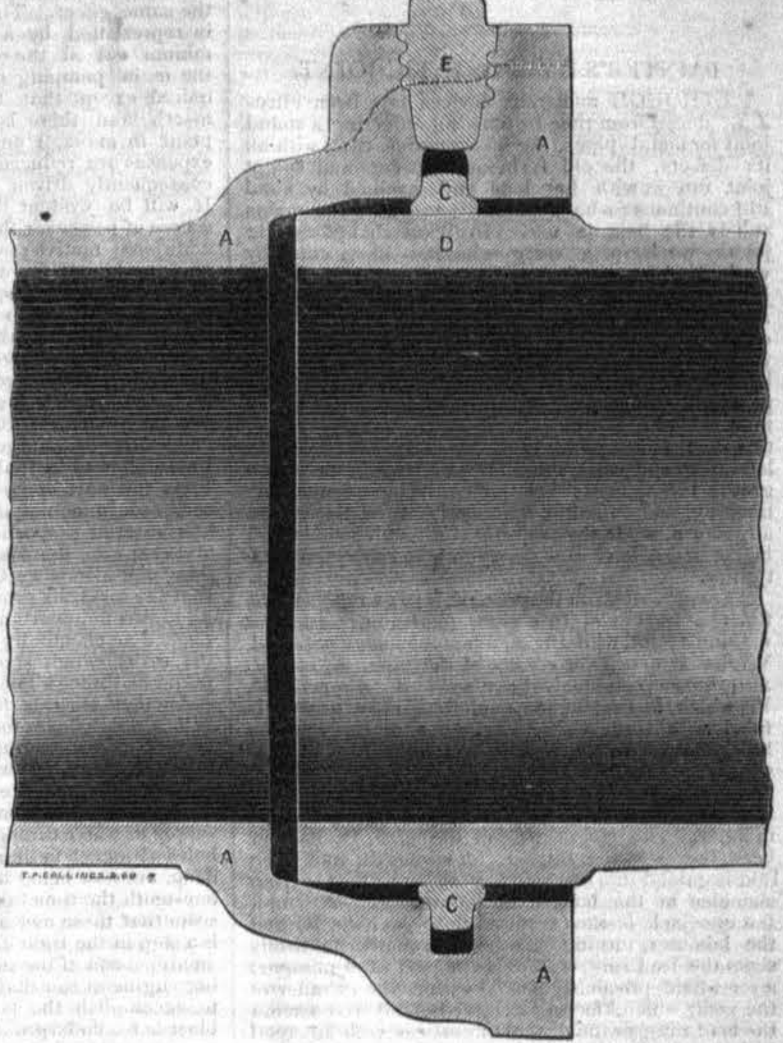

FIG. 2.

### CULTIVATING AND SOWING IMPLEMENTS.

The largest and most varied collection of ploughs was shown by M. Bajac-Delahaye, Liancourt, Oise, a giant Brabant "breaking-up" plough, for bringing waste land into cultivation, finding a place inside the Palace. This implement, shown at fig 3, ploughs 2 feet deep and requires eight or ten pairs of oxen according to the nature of the ground. The mould-boards are made in one, an arrangement which gives elasticity to the point and facilitates the turning over of the soil. The socks terminate in a blade of steel fixed by three bolts. The smaller breasts attached to the double Brabant plough (fig 4,) are for the purpose of turning in the stubble, giving the effect of the old Picardy wood plough. They raise and turn the stubble ready for being covered by the main breasts on the return passage of the plough. This action does not add much to the draft, while it is favourable to the aeration of the soil. The fore-carrage of this plough permits of working on hill-sides having a considerable inclination, the position of the plough being regulated by the grooved sector carried by the axle. When the proper cant is obtained, the stud is fixed by a nut. M. Pécard showed a perfectly new turnwrest plough of the Brabant type, with English shares and breasts. The whole arrangement is hung on joints below the main beam, and, on raising the tail end, the weight of the shares and breasts brings them over from one side to the other, where they are secured by catches. The furrow-wheels may be altered with respect to the beam; and for travelling the breasts are fixed in a horizontal position.

M. Puzenat, of Bourbon-Lancy, Saône-et-Loire, the leading maker of barrows, showed, among others, one provided with his patent balance bar for preventing the barrow from lifting at the front end, and also with spring catches for readily connecting and disconnecting the several sections, so as to increase or diminish the width at pleasure.

Messrs. James Smyth and Sons, Pleasenhall, Suffolk, and Rue Lafayette, Paris, have improved their seed drill by making the hoppers of malleable cast iron, and arranging them so that they do not require to be removed when the cup barrel is taken out of the box, as the support bearings drop away instantaneously. The new cog-wheel gearing also gives greater variation in quantity of seeding with eight wheels than was formerly attainable with twelve. This drill obtained the gold medal at three *concours régionaux* at which it competed last year. M. Gautreau has introduced an improvement into the Smyth drills by substituting for the usual change wheels a disc with various numbers of teeth set at twelve different radii. The spur pinion is thrown in gear with one or other by an arm and endless screw.

### CROP-GATHERING MACHINES.

M. Pinot-Maniglier, Vesoul, Haute-Saône, showed two of the new 1-horse, and two 2-horse "Novelty" reapers of Messrs. Picksley, Sims and Co., of which we reserve particulars. MM. Albaret et Cie have added to the Walter Wood reaper a lever and links for throwing the fingers against the soil so as to cut the corn short when going down hill. M. Pécard showed Hornsby's new combined reaper and mower, which was exhibited for the first time at Nevers a week or two ago, and gained the first medal. For mowing, the cutter bar is arranged in front, in the ordinary way, with a rolling frame for inequalities in the ground; but for reaping the cutter bar is driven by an independent short spindle and pinion at the back. The machine is also fitted with a new arrangement for controlling the rakes, a description of which would not be intelligible without the drawings. Mr. Th. Pilter showed in action Walter A. Wood's string-binder, and also the hay press he brought out last year, which has already been illustrated in IRON.* An improvement has been made in the gear of the press, whereby friction is diminished, and therefore the power required to drive reduced; and. in running back the press head, an automatic arrangement has been added which throws it out of gear, thus dispensing with the services of one man. A smaller size is in hand for forming bales half the former size, so as to be carried on the backs of mules in military operations. Mr. Pilter also showed at work a new hay-cock cart, illustrated at fig. 5 It consists of a cart without bottom or back, or axle going from side to side, with rollers at the front and tail ends on which chains replacing the bottom are hung. The front roller is for giving the requisite tension to the chains and the hind one for releasing them. The cart is loaded up by men with forks as it proceeds along the swath, and the top of the load is made conical by a man standing on the side boards provided for that purpose. The chains are released by giving the hind roller a half turn, as they are only hung on hooks, the roller is swung round horizontally, and the horse on proceeding draws away the chains, leaving the hay-cock ready formed. Two men, with this appliance, do the same work as eight without it, besides the advantages of getting a crop up quickly when rain threatens, and of placing the cocks in any convenient place, a high and dry situation, for instance, and thus leaving the rest of the meadow clear for cattle. MM. Albaret et Cie showed at work their new continuous-action hay press, which compresses 15½ cwt. of hay an hour, with three horses working a horse-gear and four men. A train of wheels reduces the speed to the connecting rod, which thrusts a square piston into an oak chamber. The end of the connecting rod, in its revolution, raises one end of a beam, which causes a toothed board fixed on to the other end to descend into a hopper at each stroke, and push down the hay as it is fed in by forks. The piston then presses this portion, which is retained by catches, and pushes the bale on. Between each bale a board is inserted with grooves, into which three wires are thrust by a rod. These are passed round horizontally (longitudinally as regards the bale) and twisted, holding the hay quite tight.

### FOOD-PREPARING APPLIANCES.

MM. Bertin et fils, Monterau, fit to their thresher an endless band with slats working over rollers for a horse to drive by merely stepping forward; and M. Aubert, Paris, showed two threshing-machines combined with a vertical boiler and engine on the same frame. M. Chaudré, Paris, had on view a completely new design of root-cutter, in which the knives are set in a fixed cylinder, while the roots are carried round them by revolving arms on the shaft, a large quantity being cut in a short time. MM. Albaret et Cie have fitted their latest thresher with a trough instead of the usual shakers, and showed a new automatic feed for threshing-machines. This firm had on view a large disc mangold slicer with twelve knives for the use of sugar-houses and distilleries. This was connected with a root-washer from which the washed roots were delivered by an endless chain. M. Mengin, St. Geneviève-des-Bois, showed a pig-trough running on rollers, so that it can be filled and then pushed forward into the stye. M. Monier, Paris, exhibited his troughs and cisterns of cement with a framework of iron inside for giving strength. One of these was half finished and half in skeleton, for showing the construction. Much attention was attracted by the press (for cyder, &c.) of MM. Rigault et Cie, Paris, the force of which was shown by crushing billets of wood laid crosswise. The cam-motion is taken from the American mower. M. Th. Pilter showed in action Laval's Norwegian creamer, which depends for its action on centrifugal force. With 1 horse-power it extracts the whole of the cream from 30 gallons of fresh milk in an hour.

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* Vol. xiii., p. 488.

## PAINTER'S HYDROSTATIC JOINT.

ALTHOUGH numerous devices have been introduced from time to time for effecting a sound joint for metal pipes, the fact remains that, with all its defects, the old fashioned socket and spigot joint run in with hot lead and caulked by hand still continues to be used for gas and water mains and is the best in use. In Painter's hydrostatic joints we have a truly scientific idea, carefully worked out for practice, and applied to the purpose of joining metal pipes in such a way as to reduce to a minimum the amount of labour and material required, whilst at the same time a perfectly tight joint is ensured. It may be briefly described as a lead joint caulked while cold by means of hydrostatic pressure. The joint is made by injecting a semi-fluid behind a lead ring cast in a groove in the socket, this fluid, flowing around between the pipe and the lead ring, compresses the latter, forcing it out of the groove and against the spigot end of pipe, spreading laterally, and caulking itself so firmly as to prevent any return, while the pressure of the fluids contained in the mains have a tendency to make the joint still tighter.

The engravings on the preceding page represent at fig. 1, a section of two pipes placed in position for making a joint, whilst fig. 2. shows the joint completed Within the bell or socket of the pipe, A, is cast. a groove communicating with a screw hole, B, which is cast upon a chill. This groove is filled with lead, C, which is poured through the hole, B, upon an expanding ring covered with felt, slipped within the socket. This is done at the foundry, and the pipes are sent out with the lead ring or gasket flush with the inside, as shown at C, in fig. 1. The spigot end of the pipe, D, has no bead, but is made thicker, for strength, and when laid is guided into concentric position by the tapering shoulder at the bottom of the socket. A small forcing jack is then screwed into the hole, B, and the labourer, turning the handles until he firmly seats the lead ring, injects (by means of a plunger) a semi-fluid, previously placed within the cylinder of the jack, which, forcing its way behind and around the lead ring, gradually compresses it with an equal pressure at all points of its circumference, until the lead, C, impinges upon the spigot, D, spreading itself laterally, and caulking itself so as to effectually prevent its return, or any leakage from within the pipe. A little clay is put in the hole, D, and a cast-iron plug, E, also cast in a chill, is screwed into place to retain the semi-fluid, and the joint is completed, as shown in fig. 2. In the case of a 12-inch pipe, the whole operation of making a joint need not take up more than six or eight minutes. The semi-fluid is composed of a preparation of pitch, whiting and sand, about the consistency of putty, and is packed in the form of paper cartridges to fit the cylinder of the forcing jack. The amount of lead required is but one-third that usually employed, and as it is forced cold it will be seen how readily this method lends itself to laying tubes or pipes of any size under water. We understand that the joint has been tested under a pressure of 1000 lb. per square inch, and deflected 9 inches in 12 feet, without leakage. Engineers in the Colonies, India, and other foreign countries where skilled labour is costly and difficult to obtain, will, no doubt, find this joint of especial service. We may add that the invention is being introduced by Mr. J. S. Fairfax, of No. 1, Queen Victoria Street, London.

## THE JORDAN ROCK DRILL.

IT may be interesting to our readers to know that a new and useful arrangement of the Jordan rock drill has been effected by Messrs. T. B. Jordan, Son and Meihé, of 52, Gracechurch Street, London. It is now well known that this drill has hitherto only been worked by hand-power, but recent modifications have rendered it capable of being worked either by steam or water power. One of the great advantages possessed by the new power drill is that it can be worked by a column of water which exists in nearly all deep mines in the pump column, thus avoiding the use of compressing-engine, boiler, receivers, and most of the plant requisite for compressed air-drills. For this purpose small water-motors are used, which are connected direct to Jordan's machine, and to do the same effective duty as the same size air-drill. It is stated that they only use an average of 7 gallons of water per minute while at work, from a column varying in height, say from 200 to 300 feet. With a greater fall, of course a less quantity of water will do the same work. By driving a main pumping-engine of ordinary dimensions, a quarter to half a stroke a minute faster than necessary for draining purposes, all the power requisite to work these drills is derived, the water-pressure being simply conveyed from the bottom of the column of pumps in small pipes to the position of the machine. The arrangement is void of all complication, as the machines and their small motors, with the necessary length of pipes, comprises the whole of the plant. The first cost, therefore, is but small as compared with that of the compressed-air machinery producing the same effect. The cost of producing the power is represented by a quarter to half a stroke per minute out of the usual five to ten strokes of the main pumping engine. No labour being required except that for the machine (two men at most), and there being but a small quantity of plant to manage and keep in order, the working expenses are reduced to a minimum, and ground is consequently driven at a comparatively small cost. It will be evident that this is a very economical source of power for the purpose, since it involves no additional motive power or plant, and consequently no extra labour for same, and the extra cost of fuel in increasing the speed of the pumping engines from 2½ per cent to 5 per cent. beyond the usual rate for draining to raise the quantity used by the drill, could hardly be appreciated. Then, again, by using the water-power at command, a great loss of power is avoided, which loss in the case of compressed-air machines reaches a rather high percentage. Another important advantage of the water-power system would seem to be that immediately the actual drilling stops the cost of power ceases, and since the time occupied in actual drilling does not bear anything like an even proportion to that of blasting, clearing, and changing the position of the machine and tools, this point also is worth considering. It may be said that the air-drills provide ventilation, and this is by no means unimportant, but ventilation can be accomplished as effectually by the same power that drives the drills, which should be utilised for ventilating purposes through fans or exhausters.

Another purpose for which this drill, combined with a small steam motor, has recently been applied by some of our leading civil engineers, is deep boring for prospecting, water searching, and other purposes. Hollow drill bars are used with this machinery and a small force pump on the engine sends a constant supply of water through the hole. It is stated that holes 3½ inches in diameter, and from 90 to 100 feet deep, are now being bored through various strata in one-tenth the time taken by hand labour. It would seem that these new applications of the Jordan Drill is a step in the right direction, and that the use of the small portion of the surplus power in the main pumping engine at the shaft head for supplying the power to accomplish the laborious process of drilling the blast-holes underground, should command the attention of mine owners and managers.

## STEAM PACKING.

THE question of a suitable material for making steam and water joints is one which has had many solutions more or less favourable in their nature. The latest, and by no means least satisfactory method of solving the question at issue is afforded by a new material for making these joints which we have recently examined, and which possesses many excellent qualities. This packing is made from wood prepared in a peculiar manner, but its method of manufacture is one of those things which are known as "trade secrets;" that is, the process is only within the knowledge of the manufacturers, Messrs. Davis and Henwood, of 28, Budge Row, Cannon Street, London. Although we are not able to say precisely what this packing is, we can inform our readers as to what its merits and uses are, and to what tests it has been submitted. We may premise that this packing is anti-corrosive and anti-galvanic, and we are informed that no corrosive ingredients enter into its composition, and that it is prepared without the use of acids or deleterious chemicals. It has been subjected to some very severe tests of which the boiling of articles made from it in molten lead was one. We have inspected samples which have undergone this treatment, and which appear to be no whit the worse for this extreme measure. We are informed that it has been used in making the joints of slide-valve chests, in the smoke-box of locomotives, and has lasted there for two weeks. It has also been used for jointing pipes worked at a nearly red heat, and after ten days the joint has been broken and re-made with the same packing. It has further been used for flange joints of water mains, 3 feet in diameter and 3 inches of metal, laid on a fall of 300 feet, with success. Cylinder cover and other joints in locomotives have been made with it for the past six months and they are still running with the same packing, and it has also been working in the piston rod gland of a stationary engine with 40 lb. steam, night and day, for the last six months, and is still there. It has been in use for four months on some of the long-journey passenger engines on one of the main lines of railway in England, and they are still running with it. For glands this packing is made to the size of the stuffing box, and each ring is made of several segments. The rings breaking joint with each other, and being self-lubricating, require only to be placed in position and screwed down; when they form chambers for the retention of the lubricant, at the same time perfecting the joint and giving a minimum of friction and a maximum of lubrication. That this packing possesses the advantages we have mentioned is shown by testimony based upon practical use, and, possessing them, there can be no doubt as to the successful future the material has before it.

## OCCASIONAL NOTES.

### THE WATER COMPANIES AND THE PUBLIC.

ARRANGEMENTS for the transfer of the metropolitan waterworks are said to be all but completed. The companies' dividends will be capitalised, and when the full statutory dividend is not at present being paid the probability of an increase is to be allowed for. If two correspondents of the leading journal are to be believed, the Grand Junction Company are taking time by the forelock, and are determined to rely on their own endeavours, rather than the generosity of the Government, for a good dividend to start with. They are at present paying 7½—not a large sum for the class of investments—and the complaint against them is that they are raising their charges 50 per cent. in some cases, in view of the impending change. One of the correspondents in question writes: "The Government have purchased their property, and the price arranged, except that a premium will be paid to accord with their increasing profits, as shown at the time of the property being made over. So, instead of showing their 7½ per cent. dividends as now, they will, by this enormous advance in their rates, get this premium raised to the scale of 10 or 11 per cent., probably more. They hold the monopoly throughout the parish, and no doubt they will cut off the supply from those who refuse to pay this extortion." A correspondent of the *Standard* has since brought a similar charge against the Lambeth and Vauxhall Company. It is possible that these companies may have had, or thought they had, reason for the increment complained of, but, remembering Sidney Smith's estimate of the corporate conscience, the representatives of the public in this case would do well to keep their eyes open.

### THE ELECTRIC LIGHT IN COAL MINES.

In view of the fatal colliery explosions which are continually occurring, it is surprising that some adaptation of the electric light has not been tried underground. It is questionable whether any of the so-called safety-lamps are quite safe under all circumstances in a fiery mine; at any rate, it is well ascertained that the men are in the habit opening them, and some of the most destructive of recent explosions have been traced to this cause. It is true that the best arrangement for electric lighting is very far from perfection; but, however crude, it is nevertheless employed in lighting thoroughfares and factories in many places successfully, and at a comparatively moderate outlay. Between the effulgence of the electric light at the bottom of a colliery, and the glimmer of the Geordie or the Clancy, there can be no comparison, the cost of the application would not be great, and it would give absolute safety to the miner, so long at least as he kept from striking matches.

### FRESH MEAT FROM AUSTRALIA.

On Saturday a number of gentlemen, chiefly connected with the Australian colonies, met on board the *Strathleven*, which arrived in port in the beginning of last week, to put to the most effectual test the preserved joints which formed part of her cargo, and to which so much interest has attached as the first attempt to import fresh meat from Australia. The voyage home lasted about fifty-seven days, and the stock consisted of 563 sheep and lambs and 65 bullocks. The meat was preserved by Bell and Colman's freezing process, and was kept in a room in which a temperature of from 10 to 15 degrees was maintained during the voyage. A hot luncheon—the meats being all part of the recent importation—was served in the ship, and the result was satisfactory, although there appears to have been a certain loss of flavour, excepting in the case of the mutton. Some butter preserved by the same process was pronounced excellent. The firm which undertook the experiment are so well satisfied with its result that they intend to establish a regular service of fresh-meat supply from Sydney and Melbourne; and as the process of refrigeration is a very easy one—in this case the temperature was reduced to an average of 12 degrees of frost by four or five hours' work of a 30 horse-power engine each day—it is suggested that it might be usefully employed in cooling the air of passenger ships in the tropics, especially in the Red Sea, where the heat is peculiarly oppressive.

### SWORDS INTO PLOUGHSHARES.

The Americans are not indeed literally turning their swords into ploughshares, but they are doing what is equivalent to that millennial operation. In the present scarcity of iron every scrap of old metal is being utilised; and in this way the Government is getting rid of old and obsolete cannon which, being made of charcoal iron, are very valuable for forge purposes. "An Ironmaster," whose statement to an interviewer is quoted in the *Iron Age*, says the War Office sold two old Revolutionary guns the other day, and he obtained one of them. "Sold them as old iron?" exclaimed the interviewer. "Yes, sir," rejoined the ironmaster; "sold them as old iron. There are a couple of them buried in a certain place and I hope to be able to get possession of these also. Old guns have been turned into account in the making of locomotive wheels and other machinery." And a much better use to put them to than manslaughter, although in their new shape they may, perchance, be the occasion of as much harm to life and limb before being a second time returned to the furnace, as they were when cannon.

### THE BITERS BIT.

The other day William Coath, head cashier of the Patent Shaft and Axletree Company, was sentenced to seven years' penal servitude for defrauding his employers. Coath's defalcations were to a very large amount, for they have compelled the company to reduce their capital by £75,000. His dishonesty seems to have been infectious, for, before his apprehension, having given £500 to one Chidley, a solicitor, for the benefit of his creditors, Chidley appropriated the money to his own use, for which, at the recent Northampton Assizes, he also was sentenced to five years' penal servitude. But the most noteworthy incident in Coath's trial was his defence. He alleged that the false entries representing the money he was charged with embezzling covered bribes, and commissions in the nature of bribes, to railway inspectors and other persons, disbursed in the interest—it is not stated to the knowledge—of the directors of the company. Mr. Justice Bowen, who presided at the trial, expressed himself very strongly against this practice of companies or their servants tampering with the agents of their customers, observing that the right name of the procedure was fraud, and that every time such bribes were given an indictable offence was committed. Whatever truth there may have been in Coath's defence, business men know how universal the practice is. It is one, too, which cuts both ways; the only permanent result being the demoralisation of confidential servants, who by trained in dishonesty for their masters, end with stealing for themselves.

### INSUFFICIENT BUILDINGS.

Much of the house property erected in London of late years is very faulty as regards materials. Old and friable bricks are used where they are out of sight, and set in mortar which is sometimes not much better than mud, and this in spite of well-devised regulations of the local authority, too often, however, rendered ineffective owing to the accessibility to tips of those whom Justice Bowen the other day, at the Stafford assizes, styled watch-dogs. Several serious accidents occurred not long ago through the giving way of balconies, apparently intended more for show than use, and on Monday last eight or ten tons of stone coping fell from some houses at Bromley, and seriously injured several children. When the system of house-building in the metropolis is considered, it ought to impress the local authorities with the urgent necessity that exists, not only for keeping a strict watch over houses while they are being built, but also for at least occasional inspection afterwards. The heavy coping one frequently sees in London is, doubtless, often very effective as far as appearance goes, but it has often a very dangerous look to those who consider how little cohesion it probably possesses.

## REPLY ON THE DISCUSSION ON FIRELESS LOCOMOTIVES.*

By M. Léon Francq.

IN submitting the following remarks upon the interesting discussion† held at the last meeting of the Institution, the author wishes in the first place to thank the President and Members for the kind reception given to his original communication. He fully concurs in the opinion of Mr. Crampton, that the chief heads of working cost with tramway engines are those for wages and maintenance. In practice this has been everywhere proved to be the case; and the main superiority of the Fireless Locomotive lies in the reduction of wages which it effects, and in its economy as regards maintenance and repairs. He admits that the working parts of the Fireless Engine are too near the ground, and has prepared designs for raising them higher, so as to save them from the effects of mud and dust. He wishes to remark, however, that the repairs required from this cause on the fireless engines employed on the Marly-le-Roi and Rueil Tramway have been insignificant. This arises chiefly from the complete absence of ashes, and also from the arrangements made for doing away entirely with metal coverings to the mechanism these latter being found, contrary to expectation, to retain the dust, which thence blows about among the parts of the engine; and thus to aggravate instead of diminishing the evil. The author would add that he cannot approve of the arrangement adopted for rising the cylinders by Mr. Brown of Winterthur That it is defective is proved by the excessively bad condition in which these engines are now found to be. In the case of the Fireless Engine there are various other arrangements by which it would be practicable to raise from the ground all the delicate parts of the mechanism.

In reply to Mr. Tomlinson, the author has not the least hesitation in maintaining that hot water may be advantageously and usefully applied for working the trains on underground railways, where the length of line does not exceed 12 to 15 miles, and where the gradients are similar to those of the Metropolitan Railway. In support of that opinion he would remark that since 2000 litres of hot water (440 gallons) are found to produce motive force sufficient to draw a load of the gross weight of 36 tons over a line 9 miles long, 12,000 litres (2640 gallons) would certainly do six times as much work, or more than sufficient to draw a train of the Metropolitan Railway, which weighs 100 tons. Therefore there are really only two points to examine, (1) the power and rapidity with which the engine can start, and (2) the possibility of storing 12,000 litres of hot water on the engine. Now power and rapidity of starting may be obtained in all cases with four cylinders, and perhaps on straight level lines with two cylinders of large diameter. Again the author's investigations show that it is possible to provide not only for 12,000 litres of hot water on the engine, but also for a large quantity of cold water for condensation. An engine on this system, instead of weighing 35 tons empty, need only weight 26 tons; so that in working order a fireless engine for underground lines would only weigh 43 tons. As to the possibility of charging the engines from stationary boilers, this would be easily accomplished by proportioning the production of the boilers to the demands of the engines requiring to be discharged in a given time. If in one hour, for instance, it were necessary to charge twelve engines, each engine ought to be filled in five minutes; this is merely a question of the section of the steam feed-pipe, a figure which it would be necessary to calculate. To charge twenty engines per hour, it would be necessary to fit up at the terminus a set of stationary boilers having an aggregate heating surface of 1800 square metres (19,400 square feet), besides reserve boilers. This cannot be considered as impracticable; and though it might require some care and forethought to establish the system, great advantages would result from the centralisation of the production of steam at a single point, from the abolition of stokers on the engines, and from the total suppression of deleterious gases, which escape from the ordinary locomotives in the tunnels, and which greatly incommode the passengers, in spite of the ventilation produced by the passage of the trains.

With regard to the question of condensation, the author considers that to condense completely by air requires much too large a surface for practical use; and that to condense completely by water requires too great a supply. Other known methods of condensation are too costly. To keep within the bounds of practical utility, the author would not attempt anything more the suppression of the noise of the escaping steam, by causing it to expand in a large expansion chamber, and then condensing it partially by contact with tubes having air circulating in them. He believes that by thus completely withdrawing from the steam which escapes all the water which it contains, the result, on underground lines, would be that the dry steam would rise promptly to the top of the tunnel, and would clear away with sufficient rapidity. Even admitting that a light vapour would sometimes find its way into the carriages, when the atmosphere was not favourable to the ascent of the steam, this would not produce serious inconvenience; for, while there are many people who avoid the London underground railways on account of the smoke, they certainly would not make the same objection to the occasional presence of a little pure steam. This, in the author's opinion, would be proved by experience, and would produce an important and rapid rise in the receipts.

For street tramways the author considers it possible to condense the exhaust steam completely; but he would ask whether its escape, without any noise, is not rather an imaginary than a real convenience? The apparatus for complete condensation constitutes a source of complication, and consequently of expense, which takes away from tramway engines much of the advantages they are intended to realise in simplicity and economy of working. He would add, that after five years' experience and consideration of the question, he is satisfied that animals are not frightened at the sight of steam; and that in reality they are more easily frightened by an engine which advances rapidly without the outward and visible signs of movement. They are also afraid of everything that produces a shrill, sudden noise, as is the case with compressed-air engines, and with ordinary locomotives, which cannot dispense either with a violent escape of steam to increase the blast in the chimney, or with safety valves, which are liable to blow off at any moment.

The author does not agree with Mr. Welch that the arrangement of the admission valves in the steam expander is likely to transform the heat of the steam into electricity. Sir William Armstrong caused electricity to be disengaged in his apparatus only by using a very high pressure of steam, by cooling that steam so as to transform it into vesicles of water before its escape into the atmosphere, and by exciting considerable friction of these vesicles against one another. It is known that the Armstrong electrical machine did not at all produce the effect sought, as soon as the steam ceased to circulate in the cooled pipes, and as soon as the friction of the vesicles of water against one another no longer continued to take place. In the fireless locomotive the balanced admission valves, from their annular section of outlet, cause very little friction; and the steam, instead of escaping cold into the atmosphere, passes into a body of vapour at high temperature and under considerable pressure, there to be superheated; there is, therefore, no production of vesicles of water, consequently no friction and no production of electricity. This has been shown also by comparative experiments. The expander is nothing else really than the slide-valve recommended by Mr. Cowling Welch, only it acts automatically, whilst an ordinary slide-valve would not so act. The author, therefore, must continue to consider the expander as advantageous, a fact of which he has convinced himself by long and minute observation.

On the question of the employment of steam at low pressure, the author observes that his opinion is not shared by Mr. Cowper nor by several other members. He believes however, that he is right on this important point, which he is glad to have submitted to the criticism of the members of the Institution. He agrees with Mr. Welch's statement that steam at high pressure is more advantageous, because its latent heat is lower, in proportion to the total heat produced, than the latent heat of steam at low pressure. But in order that this advantage may really hold, it is necessary to assume that the latent heat of the steam at high pressure has not given out a larger number of heat-units into the atmosphere after doing its work than the latent heat of steam at low pressure. We must therefore calculate for a locomotive within what limit expansion can advantageously be allowed, taking count also of the proportion of priming water carried over. The author considers that this limit is, on an average, two-thirds of the stroke. With these data it must then be seen what is the latent heat of the steam when it enters the cylinder, and when it escapes from it; the difference is the loss of useful heat given out into the air.

Taking account of these practical considerations, the author has calculated that in utilising the heat existing in steam, a locomotive engine—not a fixed engine, for it is necessary not to confound the two—gives an efficiency of 44 per cent. only with steam at 15 atmospheres, whilst the result is 60 per cent. with steam at four atmospheres. The difference of 16 per cent. is still further increased, if we compare the general results of an engine working with steam at high pressure and delivering to the cylinders 30 per cent. of water in the vesicular state, and the undoubtedly better results of an engine working with steam at low pressure, and that steam dried by the means pointed out in the paper. The difference of 16 per cent. on the contrary would be evidently diminished if the comparison were made with a stationary condensing engine of high expansion; but that which can be done by means of expansion with stationary engines cannot be done with ordinary locomotives, where the amount of priming water, the inconveniences of lead on the exhaust side, and the need of a strong current of steam in the chimney, are causes which necessitate a limitation of the expansion, and an increased loss of heat in the exhaust steam. Taking these things into account, the author was led to prepare a table, on which the statements made at the end of his paper are based. He is thus of opinion that Mr. Cowper is in error in saying than steam generated at fifteen atmospheres cannot be used at four atmospheres without great loss. Compare the case of the Fireless Locomotive to that of two vessels, A and B, in communication with each other, of which A is filled with a supply of steam at 15 atmospheres, or at a temperature of 199° Centigrade (390 Fahr.). If A is now put abruptly into communication with B, the pressure will equalise itself in the two vessels. If we suppose besides that the ratio between the two vessels is such that the common pressure in the two is that of four atmospheres (temperature 144° C., or 291° Fahr.), the amount of internal heat in the steam will not have changed, and no work will have been done. In the author's system the communication is not made abruptly, but gradually, till equilibrium is established; the result, however is the same. Now, according to the data in Zeuner's work on Heat, the internal heat of steam, saturated and dry, at 15 atmospheres, or 199° C.—in other words, the heat of the steam in the first vessel A—is given by $573{\cdot}34 + (0{\cdot}2342 \times 199^\circ) = 619{\cdot}94$ calories per kilogram. The same steam, saturated and dry, at four atmospheres, occupying the content of the two vessels, A and B, will possess an internal heat of $573{\cdot}34 + (0{\cdot}2342 \times 144^\circ) = 607{\cdot}06$ calories per kilogram. The difference between these quantities is 12·88 calories per kilogram: the steam at four atmospheres is therefore superheated by this amount, and this superheating has the effect of vapourising the minute drops of water brought over in the vesicular state.* This would not be the case on the contrary if the steam expanded directly into the cylinders; the expansion would then produce condensation, and the effect of the superheated steam in vapourising the water would not take place.

The author acknowledges that the question which he has submitted is a difficult one; but the statements advanced by him, which were so much questioned, will shortly be verified by careful experiments. These he proposes to make with a locomotive of one of the great railway companies, on which he will fix an apparatus which will give a sufficient draught without requiring any great pressure in the exhaust steam.

As a practical reply, however, to the questions and criticisms which have been addressed to him, the author may state that he has run a fireless engine on the Rueil and Marly Tramway, with the same charge of steam, sometimes simply suppressing the expander, and sometimes admitting steam by the regulator and then expanding it by the link motion according to the pressure required; and that he has never found a greater consumption of steam with the expander than without. He has observed that the superheated steam gives at its entrance to the cylinders a mechanical equivalent higher than ordinary; that the packings of the regulator and the pistons last longer than with the direct introduction of the steam; that the leakages of steam are less numerous, and that the steam exhausted at atmospheric pressure not only utilises its heat better, but also makes no noise, and is much more readily condensed.

## SCIENCE AND ART.

### A NEW METALLIC COMPOUND.

ON Wednesday evening last Dr. Granville Cole read a paper before the Society of Arts on a new metallic compound discovered by Mr. J. Berger Spence, and its application to industrial and artistic purposes. The substance in question belongs to the class known as thiates or sulphur sulphides. Nearly a year ago Mr. J. Berger Spence discovered that the sulphides of metals, combined with molten sulphur, formed a liquid. This liquid, on cooling, became a solid, homogeneous mass, possessing great tenacity, and having a peculiar dark grey, almost black, colour. It has a comparatively low melting point—viz., 320° Fah., or rather more than 100° above the temperature of boiling water. There is thus in its favour the small amount of fuel needful to supply the necessary heat for reducing the metal to a condition for use. It expands on cooling, a property not shared by the majority of other metals or metallic compounds, and for an operation like the joining of gas and water pipes this expanding property is one of great importance. It claims to resist atmospheric or climatic influences, as compared with bronze and marble. As compared with other metals or metallic compounds, its resistance of acids, is certainly superior. A smooth surface of this metal or metallic compound, now known commercially as Spence's metal, takes a very high polish.

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* Read before the Institution of Mechanical Engineers, January, 1880.

† For report of this discussion, see IRON, vol. xiv., p. 583.

* Professor Clausius has pointed out to the author that there will always be a theoretical loss in expanding by the expansion chamber, because the steam, after passing to the lower pressure, cannot be restored by that pressure to its original condition. The process is therefore a non-reversible one, and by a well-known principle of thermodynamics a non-reversible process cannot be the most efficient. The author considers that the loss due to this cause, as also to the friction of the steam in expanding, will be found to be insignificant: but it may of course dispose of part or all the 12·88 calories mentioned in the text.

These qualities tend to render the new compound very useful in many ways. The advantages which Spence's metal possesses over other materials used for artistic productions, may be summarised under three heads, viz., cheapness, facility of working, and resistance to climatic influences. As compared with lead, which is one of the cheapest of metals, it is one-third the weight; and whereas the average cost of lead for the last ten years has been nearly £18 a ton, Spence's metal only costs £15. A ton of Spence's metal being three times the amount in bulk of that of a ton of lead, it is available for three times the amount of work. It may, therefore, be considered to be nearly a quarter of the price of lead, and, consequently, very considerably less than that of bronze. Its melting point being very low, allows it to be very easily prepared for pouring into a mould, and its property of expansion, when cooling, causes it to take such a perfect impression, that the cast requires very little chasing after. In respect of a gelatine mould, which can cover a considerable surface of work without joins such as one has to make in plaster piece moulding, the metal cast obtained from such a mould would require no chasing. With regard to its resistance to climatic influences, experiments have been conducted in this direction with complete success. A polished surface of the metal has been exposed for six months in all weathers, without showing the least change.

Experiments have been made which show its great suitability for joining gas and water pipes, and from a sanitary point of view, as water has no action upon it, it would be extremely valuable for cisterns, and being almost a non-conductor of cold, pipes might be lined with it to prevent the water from freezing. To chemical manufacturers, the metal being less acted upon by acids than other metals, it may also be of service, especially as regards sulphuric acid, which is the most extensively used of all acids in commerce. The new metal has been tested with sulphuric acid, and its action is almost imperceptible. The one objection to the use of this metal in this case is its low fusing point, but when acids have only to be used up to a certain temperature, say 200° Fah., a large field may be predicted for its use. Besides the uses thus enumerated, Dr. Cole indicated many others to which the metal may be applied, for instance, joining iron to stone or wood, the tensile strain of the metal being from 650 lb. to the square inch five minutes after setting. For joining railings to stone it would, he said, answer equally as well as lead, and be very much less in cost; also for coating the holds of ships. It might also be used for hermetically sealing bottles; for covering cloth; for covering parcels that are being sent out to hot climates, thus obviating the use of the lined boxes; for preserving fruit, or other articles of consumption.

## PROCEEDINGS OF SOCIETIES.

London Association of Foremen Engineers.—At the monthly meeting held at the Cannon Street Hotel, on Saturday last, Mr. Arthur Thomas Walmisley read a paper, illustrated with numerous diagrams, on "The Bridges of the Thames, Old, New and Projected." The author treated his subject historically as well as descriptively, and an instructive discussion followed. Prior to the reading Mr. Thomas Floyd, F.G.S., was elected as an honorary member. Mr. Newton presided.

North Staffordshire Mining Institute.—At the annual meeting of this Institute at Stoke-upon-Trent, on Monday, it was reported that there were now 278 members on the register. During the past year a scientific reference library had been commenced, and arrangements had also been made for the exchange of transactions with numerous scientific societies. Classes had also been formed under the following heads:—Practical chemistry, geology, and mine engineering. It was sincerely hoped that the knowledge obtained by the attendance at the classes would enable them to battle more efficiently with the difficulties which presented themselves in their hazardous calling, and so prevent, to a very great extent, the terrible calamities that occurred in their midst, if they could not abolish the same. The Finance Committee reported the income for the past year as £266 9s. 11d., and the expenditure £348 9s. 7d. The following were elected members of the Institute:—Mr. William S. Allen, M.P., Woodhead Hall, Cheadle, Staffordshire; Mr. Ernest Craig, Manvers Main Colliery, Rotherham; Mr. Thomas Ford, sen., Milton House, Alsager; Mr. Thomas J. Ford, Milton House, Alsager; Sir Lovelace T. Stamer, Bart., Cliffe Vale, Stoke-on-Trent. Mr. John Higginbottom, Longton, was also elected a student member. The report of the scrutineers showed the following had been elected officers for the ensuing year:—Mr. W. Y. Craig, president; Messrs. C. J. Homer, James Lucas and John Brown, vice-presidents; Mr. J. G. Bakewell, treasurer; Mr. J. Richard Haines, secretary; Messrs. J. Blackie, W. S. Coe, S. Eardley, T. M. Goddard, Wm. Heath, F. Silvester, T. E. Storey, B. Woodworth, R. Berwick, W. H. Gilderoy and J. Macdonald, council. The President then delivered his inaugural address, in which he dwelt on many topics of interest, with the view of showing how members could increase the value of the Institute, and the Institute could work for the welfare of those engaged in the mining industry of the country and the community at large.

Permanent International Exhibition at Brussels.—Amongst the various arrangements which the Belgians are making for the celebration of the fiftieth anniversary of the independence of Belgium is that of a permanent International Exhibition. The Exhibition is to be open to all comers, and special arrangements are being made so as to enable foreign firms to make it a sort of branch establishment, at which their goods may be permanently on view. The administration also volunteers by special arrangement to undertake the direct representation of any firm. The building in which the Exhibition is to be held is the Palais du Midi, situated between the Avenue du Midi and the Boulevard du Hainaut, in the centre of Brussels, and between the two principal railway stations of the lines communicating with London and Paris. Full particulars are to be obtained of Messrs. Breul and Co., 9, Drapers' Gardens, E.C. In addition to this international Exhibition there are to be a national exhibition and numerous fêtes, which, it is expected, will draw large numbers of people from the provinces to the capital. The International Exhibition will be opened on the 1st May next.

Technological Examinations.—The City and Guilds of London Institute for the Advancement of Technical Education, have just issued a revised edition of the programme for their technological examinations, which are to be held in May next, at different local centres throughout the country. Under this system, any artisan can be examined, and, if he passes, obtain a certificate in any of the thirty-two subjects in which an examination is held. These subjects include nearly all the principal industries of the country, and the examinations are designed to test the knowledge possessed by workmen, of the scientific principles of their business. The additions, which appear for the first time in the second edition, are:—"Mechanical Engineering," "Treatment of Ores," "Mine Surveying," "Oils," "Fuel," and "Flax." Of these, the most important is the first-named, including as it does, so many different branches, each furnishing employment to such large numbers of workers. Classes for instruction in the various subjects have been formed at most of the principal seats of industry in the kingdom; but candidates are not obliged to study in one of these classes before entering for examination. The only test required is that the candidate should pass in one of certain selected subjects of the Science and Art Department Examination. He can do this either before or after passing the technological examination. Copies of the programme can be had gratis, and free by post, on application at the halls of the Mercers', Clothworkers', or Drapers' Companies. Liberal prizes are offered in all the subjects of examination, as well as certificates in three grades.

## MEETINGS FOR THE WEEK.

### MONDAY, February 16.

Institute of Surveyors.—8 p.m. Adjourned Discussion on Mr. W. L. Huskinson's paper on the Present Depression in English Agriculture; its Real and Assumed Causes.

Victoria Institution.—8 p.m. The Rev. C. Engstrom.

Royal United Service Institution.—3 p.m.

Royal Academy.—8 p.m. Professor A. H. Church, on the Chemistry of Marble, Stone, Wood, and the Materials of Sculpture and Architecture.

Society of Arts.—8 p.m. Cantor Lecture. Mr. Thomas Bolas, on the Manufacture of Indiarubber and Guttapercha: Vulcanisation. Various methods of Incorporation of Sulphur, &c.

Royal School of Mines.—Professor Huxley, on Dogs and their Forefathers.

### TUESDAY, February 17.

Royal Institution.—3 p.m. Professor E. A. Schäfer, on the Physiology of Muscle.

Institution of Civil Engineers.—1. Discussion on Iron and Steel at Low Temperatures. 2. Mr. W. H. Delaus, on the Use of Asphalt and Bitumen in Engineering.

Statistical Society.—7.45 p.m. Mr. Thomas A. Welton, on Certain Changes in the English Rates of Mortality.

Gresham Hall, Lecture.—6 p.m. Rev. Professor Ledger. Popular Astronomy, with Illustrations.

Society of Arts.—8 p.m. Foreign and Colonial Section. Mr. A. W. Mitchinson, on the Principal Causes of Disease in Tropical Countries, scientifically considered.

### WEDNESDAY, February 18.

British Archæological Association.—8 p.m. 1. Mr. T. G. Pinches, on Terracotta Tablets found in Assyria and Babylonia. 2. Mr. H. Syer Cuming, on a Portrait of Henry VI. in Eye Church, Suffolk.

Meteorological Society.—7 p.m. 1. Lieutenant Carpenter, on Typhoons in China, 1877 and 1878. 2. Mr. R. H. Scott, on the Reports of Wind Force and Velocity during the Tay Bridge Storm, Dec. 28th, 1879. 3. Mr. W. Merriott, on the Frost of Dec. 1879, over the British Isles. 4. Captain Watson, Thermometry on the R. M. s.s. *Algeria*.

Gresham Hall, Lecture.—6 p.m. The Rev. Professor Ledger, Popular Astronomy, with illustrations.

British Horological Institute.—8 p.m. Mr. Jame V. Poole, on Chronometer Making.

Society of Public Analysts.—8 p.m.

Society of Arts.—8 p.m. Mr. W. P. Andrew, on the Euphrates Valley Railway.

### THURSDAY, February 19.

Royal Institution.—3 p.m. Professor Dewar, on Recent Chemical Progress.

London Institution.—7 p.m. Sir Travers Twiss, on the Laws of Crusaders in Cyprus.

Numismatic Society.—7 p.m.

Royal Society.—8.30 p.m.

Society of Antiquaries.—8.30 p.m.

Chemical Society.—8 p.m. Ballot for the Election of Fellows.

Royal Society Club.—6.30 p.m.

Linnean Society.—8 p.m. 1. Dr. Aitcheson, Flora of the Kurum Valley, Afghanistan. 2. Dr. A. Gunther, on the Presence of a Phosphorescent Organ in Fishes. 3. Mr. J. Britten, Remarks on Specimens of *Myrmecodia*. 4. Mr. J. Jenner Weir, on a Three-Horned Prongbuck.

Royal Historical Society.—8 p.m. 1. Mr. Cornelius Walford, on Outline History of the Hanseatic League, more particularly in its bearings upon English Commerce. 2. The Rev. A. H. Wratislaw Dubravius, Bishop of Olmutz, 1542-1553.

Civil and Mechanical Engineers' Society.—7 p.m. Mr. James Love, on the Fracture of Cast Iron.

Gresham Hall, Lecture.—6 p.m. The Rev. Professor Ledger, Popular Astronomy, with illustrations.

### FRIDAY, February 20.

Gresham Hall, Lecture.—6 p.m. The Rev. Professor Ledger, Popular Astronomy, with Illustrations.

Geological Society.—1 p.m. Anniversary. 1. On the Geology of Anglesey, by Professor T. M'Kenny Hughes, M.A., F.G.S. 2. Notes on the Strata exposed in laying out the Sewage Farm at Sandford-on-Thames, by E. S. Cobbold, Esq., F.G.S. 3. A Review and Description of the Species of British Upper-Silurian Fenestellidæ, by G. W. Shrubsole, Esq., F.G.S.

Royal Institution.—8 p.m. Weekly Meeting. 9 p.m. The Rev. H. R. Haweis, on Old Violins.

Royal Academy.—8 p.m. Professor Church, on the Chemistry of Metals, Enamels, &c., used in the Fine Arts.

Royal College of Physicians.—5 p.m. Gulstonian Lecture. Dr. Govers, on Epilepsy.

Royal United Service Institution.—3 p.m.

### SATURDAY, February 21.

Royal Institution.—3 p.m. Professor Ernst Pauer, on the Life and Works of Joseph Haydn, with illustrations.

# METALLURGY AND MINING.

## THE DEPHOSPHORISATION OF IRON.

On Monday night last week, the Cleveland Institution of Engineers at Middlesborough continued the discussion on the dephosphorisation of iron, which engaged so much attention on a former occasion. Mr. S. G. Thomas, of London, the patentee of the process of world-wide renown which is known as the Thomas-Gilchrist process, and which is being applied on a large scale by Messrs. Bolckow, Vaughan and Co., at Middlesborough, took part in the discussion.

Mr. J. E. Stead (Pattinson and Stead), analytical chemist, first read a paper, supplementing that brought forward by him on the 16th December last. He said that since reading that paper he had made several experiments to ascertain the effect of manganese upon phosphate of lime, and also upon phosphate of manganese. Into the bottom of a small basic-lined crucible he placed 1½ grammes of phosphate of manganese, and upon the top of this 5 grammes of ferro-manganese, containing 71½ per cent. of manganese. In a second crucible a similar quantity of phosphate of lime was placed, and on the top of it the same quantity of ferro-manganese, which was carefully covered over with more phosphate of lime. Into a third crucible he also placed phosphate of lime, and over it 5 grammes of carburretted iron, containing little or no phosphorus. All these crucibles were placed side by side in a large plumbago crucible, imbedded firmly in powdered basic bricks, and after the covers were securely placed, they were covered with about one inch more of powdered lime. The lid was then placed upon the crucible, which was impounded into a furnace and heated to whiteness for about an hour. It was then removed, and the fused metallic buttons taken out and subjected to analysis. The button from the crucible which held phosphate of manganese contained 67·6 per cent. of manganese, and an increase of 1 per cent. of phosphorus. That from the crucible containing phosphate of lime had increased a little over 1 per cent., the manganese being respectively 67·6 and 68·6 per cent. The phosphorus in the decarbonised iron, which was treated in a similar manner to ferro-manganese for comparison, had not increased above one-tenth, or 1 per cent. In another experiment, where the crucible was kept in the furnace for a greater length of time, it was shown that nearly 5 per cent. of phosphorus had been gained by the metallic button of ferro-manganese. Judging from these results he thought it was very clear that manganese not only powerfully acted upon the phosphoric acid contained in phosphate of manganese, but it also had a great reducing effect upon the phosphoric acid contained in phosphate of lime. He thought that those results went to prove that it was manganese which reduced phosphoric acid from the cinder in the Bessemer converter. The matter deserved more investigation, and what between the results obtained by Mons. Pourcel and himself (Mr. Stead), he thought that before long he would be able to give a most satisfactory explanation of this phenomenon. The fact that manganese reduced its own phosphate showed them that the metal, subjected to the dephosphorising process in which it was the object to remove the phosphorus before the elimination of the carbon, told them directly that it must be as free as possible from that element, for as long as manganese existed in the metal it would have a tendency to reduce any phosphate of manganese or lime produced during the early stages of the blow. Attention had been drawn to the great desirability of supersaturating the scoria with lime, in order that the life of the linings might be prolonged. Great advantage had, it was stated, been obtained on the Continent by the use of iron containing little or no silicon, and an increased proportion of phosphorus. Several methods had been proposed to bring such iron to the converter. The first was that which was being practically carried out at Hörde, where white iron containing about ½ per cent. of silicon was used, together with a sufficient quantity of phosphide of iron, made specially for the purpose of giving the necessary amount of heat in blowing. The second was that which consisted in blowing out the silicon from the metal in a ganister-lined converter, running off the slag and then transferring the desiliconised iron at an increased temperature to the converter lined with basic bricks. This had been carried out at Messrs. Bolckow, Vaughan and Co.'s steel works at Eston. The third method was that described by Mr. Warner, in which he proposed to smelt with the Cleveland iron ore a sufficient quantity of the basic slag or phosphoretic material to give an increased proportion of phosphorus in the iron, and to desiliconise this iron with a mixture of soda ash and limestone, which he (Mr. Stead) confessed was the most rapid and complete process of refining that had ever yet been before the public. The desiliconised iron, after leaving the desiliconised converter, was taken to the Bessemer vessel, and there blown in the usual way. There were other methods of purification, one of which was that of Bacon and Thomas, in which oxide of iron and limestone was charged together with pig-iron in a cupola furnace, and the whole were melted down together. This method effected a more or less complete removal of silicon, which depended altogether upon the quantity of oxide of iron charged. The question as to which of those processes would ultimately be found most practicable and least costly was one which experience only could answer. Messrs. Krupp have patented a slight modification of this process, and, if it was thoroughly successful, the refined iron would be very valuable for puddling processes, but for the Bessemer converted would be almost useless. With reference to an important point—the disposal and utilisation of basic slag—Mr. Stead said that although it contained between 20 and 40 per cent. of phosphate of lime, the presence of from 5 to 15 per cent. of combined iron made manure manufacturers think that it would not answer to make superphosphate of lime from it. It seemed to him that as a manure it would be most valuable in a raw state, after grinding to a fine powder. The cinder, especially that which was least silicious, was valuable as a means of increasing the proportion of phosphorus in pig-iron, where the amount naturally was not high enough to give the necessary amount of heat in the converter, and also as a flux for blast-furnaces. Excepting the phosphoric acid, slag of such a nature was more valuable than an equal weight of limestone, for the metallic shots of combined iron would be obtained, and the manganese would probably have an influence in removing sulphur from the metal in the blast furnace, or perhaps, to state the matter more correctly, would prevent it from entering into combination with the iron.

Mr. Thomas, after complimenting Mr. Stead on the ability of his paper, pointed out what had been done on the Continent with reference to the dephosphorisation of iron. Perhaps the most important result that had been attained during the past six months was the complete demonstration that had been afforded of the truth of the propositions advanced some eighteen months ago, by which, in the ordinary Bessemer process, white pig could be advantageously substituted for grey Bessemer pig. The advantages of this substitution were over cold. As they all knew, a furnace working on white produced far more, and with a smaller expenditure of fuel, than when working on grey iron. There were many furnaces considerably smaller than the larger Cleveland type, which were to-day producing weekly considerably over 700 tons of white pig. Then, the waste in converting the white pig is very much smaller than when working on grey silicious iron. He was glad to say that they had within the past few weeks almost surmounted the gathering at the throat of the converter, which had proved so serious an inconvenience at Eston and elsewhere, by a very simple device. So far they had not succeeded in obtaining rapid working, but they were rapidly pulling up on the Continent. Their production from four five-ton vessels was from thirty to thirty-five thousand tons, which was considered fair enough, and to that rate they had nearly attained. But Mr. Richards and the big mill at Eston were not so easily satisfied. They were all satisfied to emulate American and the best English practice, and to do that modifications of the existing plant were necessary which they had hitherto not thought it expedient to insist on, but which were indispensable for quick working. He might say, however, that they were now spending some money to enable a large output to be produced. Five new Bessemer works were being built expressly for this process at a cost of five or six million francs. In answer to a question which had been put to him as to when they would see the new steel in the market in large quantities, he said that the five new works he had just referred to would have a capacity of over a quarter of a million tons per year if required, and nine or ten existing Bessemer works had already decided on adopting the process, or were already working it. It seemed probable that steel from phosphoric pig-iron would be speedily seen in large quantities. At present the production was small—probably not more than fourteen or fifteen hundred tons per week; and he had no hesitation in saying that when the alterations now being carried out at the works already in operation were completed, that production would be doubled. As to the prospects of the steel industry in Cleveland, he would venture no opinion, as it was a question they were better qualified to decide for themselves. He might, however, mention the fact that Cleveland pig-iron had been purchased in Middlesborough, taken to the Continent, and there converted into steel, and sold in successful competition with English steel for the American market, at a very satisfactory profit. After a few further remarks, he said he was glad of the opportunity of expressing the obligation Mr. Gilchrist and himself were under to many gentlemen in the Cleveland district who had so materially assisted them in bringing the dephosphorising question to its present condition, and he wished specially to mention Mr. Winsor Richards, manager of Messrs Bolckow, Vaughan and Co., and Mr. J. E. Stead, of the firm of Pattinson and Stead, analytical chemists, the latter of whom, he discovered long ago, was always ready to act as an impartial and most accurate critic of the crude hypotheses which constantly occurred so them, as affording possible clues to the solution of practical difficulties, and they had never failed to avail themselves of such suggestions.

Mr. Ed. Williams, who followed, said if Cleveland pig could be bought in Middlesborough, taken to the Continent, converted into steel, and then sold in competition with English steel at a profit, he thought it singular if they could not convert it into steel at home at as low a cost.

Mr. Jeremiah Head made a few remarks in commendation of Mr. Stead's paper. Mr. Stead took his subject up and investigated it thoroughly. He did not hesitate to take other people's opinions and investigate them, but in the main he went to Nature for his facts, and having got them he tested them, and came to place them before the Institution as if they were nothing in particular. He had come to the conclusion that puddling at a high temperature produced iron much better than at a low temperature, because it was more intimately combined. That view was singularly confirmed by the almost obsolete methods of Crompton and Banks. In other methods a large portion of the fettling was melted down and came in contact with the iron, and the effect of that was that the iron was very pure. He had been particularly interested to hear what Mr. Stead had to say about manganese. He seemed to have obtained remarkable results. They would be struck with the simplicity of the Thomas-Gilchrist invention now it was before them. It was but an example of Columbus and the egg over again. Their bases should be narrowed down to bricks of manganese limestone, which contracted immensely at a high temperature. This was the foundation of their success. Now they knew that shrinkage made all the difference. With regard to Krupp's method of refining iron, Mr. Krupp appeared to have adopted another process, and to have succeeded so far; but it seemed to him, after listening to Mr. Stead's papers, that the Krupp process was only a very short one indeed. It was very interesting to hear of Mr. Richards' process of blowing the lime through the iron; it seemed to succeed from the common reason that every bit of lime was made to do its work. It would be interesting to know if anything had been done to applying the process to the Siemens furnace.

Mr. T. Marshall asked how long the basic-bricks should be burnt.

Mr. J. W. Willans required if Mr. Stead in his investigation had ever considered how far it was possible to obtain the metal lining which Mr. Riley explained to the Iron and Steel Institute.

Mr. C. Wood saw no difficulty in blowing lime through the metal. He was grinding very large quantities of oxide and measuring them with great nicety by passing them through a sieve of twenty-four meshes to the square inch. He was doing this at the rate of six or seven tons per day.

Mr. R. Howson expressed his opinion that the system of puddling carried on in the Cleveland district was a most barbarous one, and must evidently die out.

The Chairman most heartily in what had been said as to the merit due to Mr. Thomas's invention and Mr. Stead's paper and thought that the Institute was much indebted to Mr. Stead.

Mr. Thomas and Mr. Stead both replied to the comments made.

A hearty vote of thanks was accorded to Mr. Stead for his papers, and the proceedings then terminated.

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SOUTH STAFFORDSHIRE MINES DRAINAGE. — The South Staffordshire Mines Drainage Arbitrators have issued an award respecting the proposal for altering the Bilston and Tipton district boundaries for mines drainage rating purposes. They recommend the annexation of the greater portion of Bilston to the Tipton district, as the water from the mines above the Tipton district comes down into it. The only part to be left out is the locality surrounding the town of Walsall, and all the rest, if annexed, will become liable to mines drainage rates.

RECKLESSNESS OF MINERS.—On Wednesday, at the Barnsley Police-court, a miner who had been in the employment of the Wharncliffe Silkstone Colliery for fifteen years, was fined the sum of £1 and costs for having wilfully damaged a safety-lamp. A youth was also fined £1 and costs for having, in October last, damaged a safety-lamp at the Old Oaks colliery. In the year 1866 360 men were killed by an explosion there. At Sheffield, on Tuesday, three colliers were fined for having neglected to set up sufficient props in a drift pit near Chapeltown, thus endangering their own lives and the lives of others.

PROSECUTION OF THE MANAGER OF A MINE.—At Willenhall, on Monday, Michael Harles, certificated colliery manager of the Pelsall Coal and Iron Company, was charged with neglecting to provide adequate ventilation. In November an explosion occurred, by which six miners were killed. The Government inspector deposed that the explosion arose from the gas which had accumulated in the sump, beneath a scaffold from which the men worked. Instead of the air-pipes being carried through the scaffold into the sump, the pipes stopped short of the scaffold by nine and a-half feet. The maximum penalty of £20 and costs was imposed.

MINING ACCIDENTS.—The committee of the Central Association for Dealing with Distress Caused by Mining Accidents, formed at the conference recently held in Manchester under the presidency of Lord Lindsay, M.P., held their first meeting at Leeds on Wednesday. Mr. C. G. Jackson (Wigan Coal and Iron Company), chairman of the Board of Management of the Lancashire and Cheshire Permanent Relief Society, was elected chairman of the committee; and Mr. John Howie, who holds the same office in the Northumberland and Durham Society, was chosen as treasurer. Other members of the committee present were—Messrs Inns (chairman) and Watson (secretary), of the West Riding of Yorkshire Society; Mr. William Pickard, vice-president of the Lancashire and Cheshire Society; Mr. A. Blyth, secretary of the Northumberland and Durham Society; and the secretary, Mr. G. L. Campbell. It was resolved to issue a report of the transactions of the Manchester conference, and the editing of this was placed in the hands of Mr. Campbell, who promised to write an introductory chapter on the history of the Permanent Relief Society movement since its commencement in 1862. Deputations were appointed to wait upon the boards of management of the several relief societies represented on the committee to discuss the desirableness of united action and to consider the programme of the association, and steps were taken towards initiating relief societies in Scotland, South Wales, and South Staffordshire. Sub-committees were appointed to watch the Bills before Parliament likely to affect the interests of relief societies; to report as to the forms prescribed by the Registrar of Friendly Societies for annual returns and quinquennial valuations and to prepare a model set of rules. The secretary was directed to communicate with the secretary of the Hartley Relief Fund with a uiew of the committee of that fund receiving a deputation as to the disposal of the Hartley surplus.

## RAILWAYS & TRAMWAYS.

NEW RAILWAY.—A new line between Staines, Colnbrook, and West Drayton, has, it is understood, been projected, and it is expected that the works will shortly be commenced.

NEW SPANISH LINE.—The Spanish Government has agreed to a contract with a syndicate of bankers in France for the construction of a railway which will open the mining districts of the Asturias and the rich corn-growing districts of Castille. The new line is to be completed in five years.

NEW TRAMWAY.—The towns in the Staffordshire Potteries are now to be connected by a tramway extending 4½ miles, to be constructed and wokred by the North Staffordshire Tramways Company. Distinguishing features of the undertaking are that the trams will be worked by steam power, and that goods traffic will be carried at night.

THE FORTH BRIDGE.—The contract for the Bessemer plates for the girders of the Forth Bridge has been secured by Herr Krupp, the well-known German gun manufacturers. The total weight of steel required is 10,000 tons, and the difference between Herr Krupp's price and the quotations of British firms is somewhat startling. The contractors for the bridge, Messrs. W. Arrol and Co., Dalmarnock Ironworks, Bridgeton, state that they found a difference of £3 per ton between the lowest British tender and that of the German manufacturer.

FLOATING RAILWAY STATION.—The model of a monster floating railway station has just been made by Messrs. Palmer's Shipbuilding and Iron Company, Jarrow, from the plans of one of their draughtsmen. The idea consists in connecting England with the French capital by railway, the floating station being so constructed as to carry trains across the Channel the rate of 14 knots, thus minimising sea-sickness, and obviating the necessity for unloading goods. Each train would provide accommodation for 2000 passengers. The model has been forwarded to London for the purpose of being thoroughly examined by the Admiralty officials.

CONTINUOUS BRAKES.—The *Chicago Railway Review* of January 17th, says that a terrible bridge disaster was barely averted on Sunday at Boston by the alertness of the engineer of a New York and New England train and the Westinghouse air-brake. The large iron steamer *Lancaster* had crashed into the railway bridge beyond the Congress Street draw because a broken bellwire had failed to give the steamer's engineer the signal to stop, badly twisting the bridge timbers, breaking the draw-lock, and deviating the rails 18 inches out of line. No one was on the bridge or in the vicinity to warn the inward-bound train, whose engineer saw the trouble when but a train's length from the bridge. He reversed and applied the brake, stopping the five cars 15 feet from the bridge abutment. But for this the train would have gone into the river, and, as the tide was high, the loss of life would have been great. The history of actual railway disasters is appalling enough; but there is an unwritten history of accidents which ought to convey just as important lessons.

## ELECTRICITY, TELEGRAPHY

EDISON'S ELECTRIC LIGHT.—The Philadelphia correspondent of *The Times*, under date the 20th ult., writes that the failure of Mr. Edison to get his light into practical operation is causing much criticism. At the beginning of the year he had about sixty lamps in successful operation, and his little carbon loop or horseshoe was glowing in them and furnishing a light that effectively replaced both gas and petroleum. He was run down with visitors and investigators, and in the rather loose way in which business was conducted in his workshops, this seriously interfered with the manufacture of more lamps. He had the lamps put up in the shops, houses and grounds, keeping accurate records of the performances of each. About ten days ago he found that quite a large proportion—some fifteen or twenty per cent.—of the lamps were developing leaks, showing the vacuum to be defective, and he then experimented upon systems of obtaining a more perfect vacuum by trying different forms of lamps. Whenever the lamp maintained the vacuum, its performance continued perfect, and this was the case with many of the earlier lamps manufactured. But Mr. Edison is not content with this, and he desires to reduce the proportion of defective lamps to the smallest possible figure, and with this object his experiments are going on. The point where the platinum wires pass through the glass gives trouble on account of differences in expansion when the lamps are lighted. The tube at the upper side of the lamp through which the air is exhausted, and which is afterwards sealed up, also sometimes develops leaks, so that it seems to be demonstrated that effective sealing cannot always be secured when one side is a vacuum. The experiments are directed to remedying these defects in the construction of the lamp. When the vacuum is maintained, the lamp burns as successfully as ever, but as the time test has developed these difficulties, they must be surmounted before steps can be taken to put the invention in practical use. Hence nothing has yet been done to bring the lamp into operation outside Menlo Park; and there are all sorts of criticisms and cavils at the delay. There are now about eighty lamps in operation at Menlo Park, some with changes of construction designed to obviate the defects that have been developed, and while Edison's friends claim that the difficulties are overcome, it does not yet seem to be practically demonstrated. Meanwhile the delays and adverse rumours are having their usual effect, and the Edison Light Company's stock, which had advanced to $3500 per share, has declined to $1500 for $100 shares.

AN ELECTRIC RAILWAY.—At the general meeting of the new Electro-Technic Society—a body rapidly assuming importance among the philosophical associations of the German capital—Dr. Werner Siemens made a most interesting statement upon the impending construction of an Electric Railway. Fifteen feet above the pavement he proposes to construct a network of electric lines, intended to convey passengers from the various stations of the new metropolitan line to all parts of the capital. To work these lines with ordinary locomotives would be impracticable, unless, indeed, the pillars on which the metals would have to be placed were very solid, and of a nature not to interfere with the traffic of crowded streets. The Electric Railway required no such heavy structures, the moving power being the new dynamic machine, invented by the speaker, and perfected by Herr von Hefner, one of the leading engineers of his firm. For its working capacity the machine was indebted to a very simple contrivance. By revolving his machinery in the direction opposite to the current he had not only obviated reduction of force, but actually augmented its strength. This theory, which was communicated by him thirteen years ago to the Berlin Academy, had since been applied by Dr. Siemens and his associate, Herr von Hefner, to the construction of an electro-dynamic engine, whose perfect working capacity was tested in the Electric Railway of the Berlin Industrial Exhibition of 1879. The machine was so very powerful that the chief difficulty in perfecting it had been to prevent its destruction by its own inherent force. The action of the machine, too, was cheaper than that of the locomotive; a train consisting of machine and passengers' carriage could be profitably run on his viaduct railway, if there was an average of five travellers. Considering that the electric viaduct admitted of being placed on slight and elegant columns, it was obvious that this new species of railway supplied a ready means of freeing the streets of crowded capitals from the excessive traffic now obstructing them. He was not prepared to say that the new invention would supersede locomotives for long distances, a dynamic machine in connection with the engine requiring to be put up every twenty miles; but as its applicability for short distances had been absolutely proved, omnibus and tram were clearly destined to become obsolete very shortly, and metropolitan communication would be conducted upon a new and highly improved plan. In conclusion, the speaker hoped that Berlin would be the first city to adopt this promising contrivance. Herr Siemens then discussed the feasibility of employing his engine for increasing the traction power of locomotives in overcoming ascents too steep to admit of the requisite friction of the wheels. He also showed that the Berlin postal *trubes*, in which letters are conveyed by compressed air, might be more advantageously worked with his dynamic machine. The meeting, which was presided over by Postmaster-General Stephan, listened to these extraordinary disclosures of the famous electrician with the highest interest. In a letter to a Berlin journal, Dr. Werner Siemens contends that he was the first to divide the electric light and to utilise the same for practical purposes. In proof of this he refers to his electric illumination of the Berlin Imperial arcades, achieved long before Mr. Edison's experiments.—Berlin correspondent of *Standard*.

# NAVAL ARCHITECTURE.

## LAUNCHES.

### English.

*Lemnos.*—On the 31st January, Messrs. Short Brothers launched from their shipbuilding yard at Pallion, Sunderland, a screw-steamer for Messrs. Lumsden, Byers and Co., of Sunderland, of the following dimensions:—Length, 260 feet, breadth 34 feet, and 18 feet 6 inches depth of hold; classed 100 A Lloyd's Registry, to carry about 2150 tons dead weight on a light draught. She has iron decks, four steam winches, and all the latest improvements, and is to be fitted with engines of 140 horse-power, by Mr. George Clark, of Southwick Engine Works. On leaving the ways the vessel was named the *Lemnos*. She will be commanded by Captain Clarkson, and is intended principally for the Black Sea trade.

*Muriel.*—There was recently launched from the yard of Messrs. Raylton, Dixon and Co., a screw-steamer, named the *Muriel*, which has been built to the order of Messrs. Rayner and Murray, of Middlesborough. Her dimensions are:—250 feet long, 33 feet beam, and 17 feet 9 inches depth of hold, built with long raised quarterdeck, and cabins under the bridge. Her decks are of iron, and she has four steam winches, and all modern improvements. Her carrying capacity is about 1840 tons, and she will be fitted with engines of 120 horse-power by Messrs. Thos. Richardson and Sons, of Hartlepool. On leaving the ways she was christened the *Muriel*.

*Silver Dart.*—On the 28th Jan. a fishing boat, called the *Silver Dart*, was launched from the building yard of Messrs. Hastings Brothers, at Yarmouth. She belongs to Mr. W. Thrower, of Admiralty Road, and is built on the Penzance principle, being the first vessel of that description built at Yarmouth.

*Utrecht.*—On the 11th February Messrs. Raylton, Dixon and Co. launched from their Cleveland Dockyard the *Utrecht*, a very handsome iron screw-steamer of 2250 tons gross register, and 220 horse-power nominal, for the Rotterdam Lloyd's mail line between Holland and Java. The dimensions of this vessel are:—Length 315 feet, breadth 36½ feet depth 27 feet. She is classed 100 A 1 at Lloyd's, and will be fitted with cabin accommodation for first-class passengers in large deck house especially arranged for good ventilation, and containing large saloon pa[n]elled in polished marble. The *Utrecht* is a sister ship to the *Gelderland*, built by the same firm some time ago.

### Scotch.

*Balgownie.*—On the 29th Jan. an iron screw-steamer, named the *Balgownie*, was launched from the building yard of Messrs. Alex. Hall and Co., shipbuilders, Aberdeen, the dimensions of which are:—Length, 235 feet; breadth, 31 feet; and depth, 17 feet. The vessel is of 120 horse-power, and 1150 tons register, the owners being Messrs. J. and A. Davidson, Aberdeen.

*Donata.*—On the 2nd February the London and Glasgow Shipbuilding Company launched a very handsomely-modelled screw-steamer, built to the order of Messrs. Bahr, Behrend and Ross, Liverpool, on account of the "Linea de Vapor Serra," for their trade between Liverpool, Spain and Cuba. The vessel has been built under the superintendence of Mr. G. S. Goodwin, Liverpool, to highest class of Lloyd's and French Veritas, her dimensions being 210 by 28·6 by 16, and gross tonnage about 750 tons. She will be fitted by her builders with compound surface-condensing engines of most approved description for economising fuel. As the vessel glided from the ways she was named *Donata*.

*Glenwilliam.*—On the 30th January Messrs. H. M'Intyre and Co., Merksworth, launched the *Glenwilliam*, an iron screw-steamer of 500 tons, which has been built to the order of Mr. Wm. Sim, Glasgow. The *Glenwilliam* is a very handsomely-modelled steamer, with a long, full poop and topgallant forecastle, and accommodation for captain and officers under the bridge. The steamer has a patent windlass and steering-gear, and all her fittings are of the most approved construction. The engines, which are compound surface-condensing, have been made by Messrs. Hutson and Corbett, Glasgow.

*Rambler.*—There was launched on the 26th inst., from the shipbuilding yard of Messrs. Elder and Co., Glasgow, a screw composite gunboat for the British Government, named the *Rambler*. Her length is 157 feet; breadth, 29 feet 6 inches; and depth, 14 feet 5 inches. She will be fitted with two chaser 64-pounder guns, one in the bow and one astern, and a broadside gun of 20 cwt. Her engines are to be 750 horse-power. Messrs. Elder are also building a sister ship to this and a paddle despatch-boat for the Admiralty.

*Ranger.*—Messrs. Elder and Co., of Glasgow, launched for the Admiralty, on February 12th, a single-screw composite gunboat, named the *Ranger*. She is 157 feet in length, 29½ feet broad, and 14 feet 5 inches in depth, with a mean draught of 11 feet 9 inches aft, and 10 feet 6 inches forward. She is to be armed with two 64-pounders, and one broadside gun of 90 cwt. The engines will indicate 750 horse-power.

*Vagliona B.*—On the 24th of January Messrs Thomas B. Seath and Co. launched from their shipbuilding yard at Rutherglen an iron twin screw-steamer of the following dimensions:—175 feet in length, 27 feet beam, and 6 feet 9 inches depth. The vessel is intended for the grain trade on the Danube, Don and the Black Sea, and is especially fitted up for the trade, being built with seven water-tight compartments, and also supplied with steam winches and all the most recent improvements for the rapid loading and discharging of cargoes. The machinery, which consists of a pair of compound engines of 50 horse-power, is supplied by Messrs. A Campbell and Son, Anderson Quay, Glasgow. On leaving the ways, the vessel was named the *Vagliona B.* The *Vagliona B* is a companion steamer to the *Vagliona A*, launched three weeks ago by the same firm for Messrs. Vagliona Brothers, of London.

### Trial Trips.

*Badibow.*—This steamer, which was built by Messrs. Edwards and Lyones, of Cubitt Town, London, was successfully launched from their shipbuilding yard on the 17th of January last, and was ready for the trial trip on the 30th, that is a few days within ten weeks of the receipt of the order. This steamer is 105 feet long, 16 feet beam and 8 feet deep, and was built to the order of the Marseilles house, Messrs. Gounelle et Fils, for opening up the river Gambia on the West Coast of Africa, 200 miles from its mouth. She is classed 80 A 1 at London Lloyd's, and is fittad with compound surface-condensing engines of 30 nominal horse-power. She is fore and aft schooner rigged, and will carry 60 tons dead weight on a draught of water not exceeding 5 feet 6 inches. Owing to the dense fogs which have lately prevailed the trial did not take place until the 4th inst., when, with the load as above, a speed of over nine knots on the measured knots on Long Reach was obtained, the machinery working satisfactorily at 150 revolutions per minute, and the boiler maintaining a pressure of from 65 to 70 lb per square inch. Messrs. Edwards and Lyones have now constructed steamers for nearly all the principal rivers of Africa, also some for the South American rivers. Last year they built the *Yola* (light draft twin-screw) for the river Niger, and another for the Nile, and from the reports sent home to owners these vessels appear to be giving great satisfaction.

*Billiton.*—On February 9th the new steamer, *Billiton*, built by Messrs Blackwood and Gordon for Lee King Yong, of Singapore, went down the Clyde on her trial trip. She left Port Glasgow at 11 o'clock, and steamed straight to Wemyss Bay, where she ran the measured mile down and up. The mean speed attained was at the rate of a little over 10 knots an hour, which, taking into account the unfavourable condition of the weather, was considered quite satisfactory. The *Billiton* afterwards went up Lochlong as far as Ardentinny, and then turned and steamed to Port Glasgow.

*Laxham.*—On the 3rd February, the screw-steamer *Laxham* was taken on her trial trip. The *Laxham* has been built by Messrs. John Readhead and Co., South Shields, to the order of Mr. Robert Harrowing, of Whitby. The *Laxham* is 243 by 32½ by 17½, has a gross tonnage of 1300 tons, and will carry a deadweight of 1850 tons. Her engines (of 110-horse power nominal) have also been built and fitted by Messrs. Redhead and Co. The vessel was taken out to sea, and after having her compasses adjusted, was taken to the north and south of the harbour, and the trial proved very satisfactory, the vessel maintaining a speed of over eleven knots per hour. The vessel loads immediately for the Mediterranean.

H.M.S. *Superb.*—The *Superb*, 15, 1760 tons, 7430 horse-power, broadside ironclad ship, arrived in Chatham harbour on Tuesday, from the Nore, on the completion of an extended series of steam trials in the Channel. The general results of the trials were by no means so satisfactory as had been anticipated would be the case considering the enormous amount which the vessel has already cost the Government. The *Superb* has, up to the present time, been a most costly ship to the country, and a still further large sum will have to be expended on her before she is ready to proceed to sea on her first cruise. She was one of the vessels purchased from the Turkish Government out of the vote of credit.

*Tisza.*—On the 29th Jan. this new steamer ran her trial trip on the Clyde. In running the measured mile the speed attained is stated to have been 11 knots, which, considering the state of the weather and the fact of the steamer being so light that her screw was 6 feet out of water, was satisfactory. On returning to Greenock the vessel anchored at the Tail-of-the-Bank. The *Tisza*, which was built by Messrs. Blackwood and Gordon for the Adria Steamship Company, of which Messrs. Burrell and Son, of Glasgow, are the managing owners, is under the command of Captain Lee, and proceeds to Cardiff to load coal for Palermo.

*Weatherall.*—The trial trip of the steamer *Weatherall* took place recently. The steamer has been built by the Tyne Iron Shipbuilding Company, to the order of Messrs. Fisher, Renwick and Co., of Newcastle-on-Tyne, and the engines have been constructed by the Wallsend Slipway and Engineering Company (Limited), and are 22 and 44 by 30-inch stroke. The boiler is of steel, made by the West of Scotland Steel Company, and carries a working pressure of 100 lb. After the compass was adjusted, the vessel was run to the northward, in order to test the performance of the engines, which gave satisfaction; but the vessel being perfectly light, no definite results were obtainable. The *Weatherall* sailed on Monday, when another trial was held, and with steam at 100 lb. in the boiler and 72 revolutions, an indicated horse-power was obtained of about 440, and a speed of ship of over 10 knots. The glands of the high-pressure engine were fitted with metallic packing, and the engine is also supplied with other details to provide for a working pressure of 100 lb.

Disasters at Sea.—There were thirty British and foreign wrecks reported during the week ending Saturday last, making a total of 153 for the present year, or a decrease of 112 as compared with the corresponding period of last year. The approximate value of property lost was £450,000, including British £385,000.

Fatal Explosion on Board a Coal-laden Ship.—An explosion occurred on Monday morning on board the steamer *Columbine*, of Hull, as she was leaving Cardiff docks. She had on board 1850 tons of steam-coal, bound for Bordeaux. A seaman named Fanning was in the after hold, and it is supposed that he lighted a match, when the gas below the cargo exploded, blowing away the deck and after cabin, and blowing Fanning almost to pieces. The second engineer, Carkwell, and Allcock, a seaman, were much injured; the second mate, Watson, was blown overboard, but was picked up alive. The hatches were not battened down, but as the vessel was built for iron ore cargo, the gas accumulated under the trunk.

The Liverpool Sewage Steamers.—The screw sewage steamer *Alpha*, belonging to the Liverpool Corporation, made her first trip to sea on Thursday last with about 250 tons of town refuse. She steamed out of the River Craft Dock to the north of the North-West Lightship, where she deposited her cargo at the place indicated. The North-West Lightship is 18 miles from the Rock Light, and about 23 miles from the River Craft Dock, a small dock (nearly an acre in extent) used by small barges and schooners bringing slates from the Welsh quarries. A berth is appropriated to the Liverpool Corporation, who recently sold this property to the Mersey Dock Board, for the barge and hopper to receive the town's refuse, and a shoot is fixed for the purpose of damping it into the new steamer. The first voyage made by the new vessel has proved satisfactory. She occupied about 4½ hours on her outward and 3½ hours on her homeward passage, and is said to be an improvement upon the screw hopper barges of the Mersey Dock and Harbour Board. The voyage occupied eight hours altogether, or within one tide, and this answers the requirements. The new vessel, which differs materially from the ordinary hopper barge, was built by Messrs. William Simon and Co., Renfrew, a firm who have for many years advocated the use of such steamers for the disposal of town refuse.

# ARMS, ARMOUR AND EXPLOSIVES.

Heavy Breech-loaders.—Before the close of the present year the demonstration made by Herr Krupp last autumn at Meppen will meet its response at Woolwich and Shoeburyness. Two large breech-loaders, intended to show results superior to any yet accomplished, are in course of construction in the Royal Gun Factories at Woolwich Arsenal. The largest, weighing 43 tons, will have a bore 12 inches in diameter, and no less than 26 calibres long. The Krupp gun of 71 tons is rather less than 22 calibres long in the bore, and our present 80-tun gun has a bore only 18 calibres in length. The other large breech-loader now being constructed at the Arsenal is to weigh 26½ tons, having a bore 10·4 inches in diameter. This also will be 26calibres in length. It is expected that the projectile fired from this gun will have a velocity exceeding 2000 feet per second. Both guns will be chambered. The mode of construction is that of the Fraser system, but with a greater thickness of steel than hitherto in the rear part of the tube, to admit of the requisite breech-closing arrangement, which will be a modification of the French. The projectiles of these guns will be rotated by a copper ring near the base, after the manner employed by Mr. Vavasseur. A steadying ring will probably encircle the shot near the shoulder.

The Thunderer Gun Experiments.—The fragments of the 38-ton gun destroyed by bursting at Woolwich have all been recovered. There are about 130 pieces. They have all been marked, and are to be washed and arranged for inspection. The two projectiles, Palisser and common shell, seven and six hundred pounds respectively, with which the gun was loaded at the time, were taken from the sand butt in front of the gun. Both are broken in pieces, and it is evident from the rifling being effaced in places in the bore that they broke up before leaving the gun. About three feet of the muzzle end of the steel tube lining the gun's bore was taken from the sand intact, whilst only part of the wrought iron super coil remained around it. The breech end of this fragment presents the appearance as if it had been struck heavily by one of the projectiles. The crusher gauges attached to the shells have also been recovered, but they give no indication of what the bursting pressure was, although they prove the pressure could not have exceeded 35 tons, and would not have been alarming in the powder-chamber. [We have received a copy of a letter addressed by Sir William Palliser to the Secretary of State for War on the results of the experiments with this gun, the consideration of which, however, pressure on our space obliges us to postpone until next week.—Ed. Iron].

Messrs. Cammell's Steel-faced Armour.—A service contemporary is responsible for the following announcement:—The superiority in powers of resistance of compound steel-faced armour over all other descriptions of armour-plates has been made so thoroughly manifest that the Admiralty have finally adopted it for the defence plating of our ships of war. The saving of weight by the adoption of compound is also a great gain, it being no less than 600 tons in such a ship as the *Inflexible*, the steel-faced armour enabling the plates to be reduced two inches in thickness, while the resistance power is greater. Our Portsmouth correspondent has telegraphed to us on several occasions the success which attended the gunnery experiments with Messrs. Cammell's composite armour plates of iron plates plated with steel, and has also intimated that the Admiralty have expressed their satisfaction with the results; but this announcement goes much further, and implies the development of a large branch of local industry, for Messrs. Cammell's plates have been the only ones of a composite character which have been tested. At present the experiments have immediate reference solely to the outer armouring of the *Inflexible's* turrets, but it was officially understood that in enabling the relative resistance of compound and iron armour plates to be determined, a problem of vital interest not only to the manufacturers of plates, but also to the navy, would be solved. If compound plates are to be adopted for the defensive plating of men-of-war, the demand which will have to be made by the Admiralty upon Messrs. Cammell will be enormous, for the successful process indicated by Mr. Wilson of welding the two metals together is patented and cannot therefore be carried out in the Royal dockyard.—In reference to this statement, Messrs. John. Brown and Co. write to the *Sheffield Daily Telegraph* :—"Your correspondent leads the public to infer that Messrs. Charles Cammell and Co., Limited, have been the only manufacturers of the steel-faced armour plates now approved by the Government, and, in fact, states that Messrs. Charles Cammell and Co.'s steel-faced plates only have been tested. This is entirely incorrect. No less than seventeen steel-faced plates made by this company have been tested by the Government—some at Portsmouth and some at Shoeburyness. The experiments at the latter place with iron and steel-faced plates against steel shell, which are referred to by Mr. Barnaby in his report (alluded to in *The Times* of Friday last), were more conclusively in favour of steel-faced plates than any previous experiments, and the plates in question were made by this company, under a patent taken out by the chairman, Mr. J. D. Ellis. The Government have also shown their appreciation of our steel-faced plates by giving us the order for those required for the turrets of H.M.S. *Ajax*, and the representatives of the Argentine Republic were so satisfied with the tests that we have received orders for half the plates for a ship of war now being built for them by Messrs. Samuda Brothers."

## NOTICES OF BOOKS.

*The Countries of the World.* By ROBERT BROWN, M.A., Ph.D., &c. London: Cassell, Petter, Galpin and Co.

THE present part of this work, which has reached its fourth series, contains a description of the islands of the Pacific, compiled from recent and authoritative sources, much of it consisting of direct quotations; and the text is illustrated and enlivened by 317 effective woodcuts, many of them full-page engravings of ethnographic, natural history or topographic subjects. The matter is selected with considerable judgment, and although not full enough for purposes of reference, the general reader, after a perusal of the volume, will, in all probability, have obtained and retained a larger amount of information regarding the countries described than he could have acquired from geographical works of a higher class. The South Sea Islands have kept much of the interest that attached to them on their discovery, owing to their climate, vegetation, and the primeval simplicity of their inhabitants, and latterly there is the additional interest derived from the unique peculiarity of their formation, which was first elucidated by Mr. Darwin. Australia and New Zealand have in recent years become of immense importance to this country as receptacles for its surplus population and in commercial intercourse; and it is indeed a remarkable coincidence, in relation to the first of these conditions, that at the time when the American colonies were beginning to be disaffected, and six years before they ceased to be part of the British Empire, England, by taking formal possession of New South Wales, added to her colonies a southern territory nearly equal to the rebel States in area, quite equal to them in mineral wealth, soil and climate, though inferior in the area of country fitted for the abode of man. The remarkable resemblance of the scenery of New Zealand to that of Great Britain is noted, and the mineral treasures both of that island and Australia are adverted to at suitable length. The unproductive nature of the search, notably for gold, but in a less degree for other metals, is distinctly brought out. As on the racecourse, for one markedly successful adventurer hundreds are ruined. "Gold," remarks the author in describing New Zealand, "is not a product which is to be depended on as a stay for any country, though it may give it a temporary fillip." The gold fields of New Zealand have, however, been very productive, yielding from 1861 to the end of 1877 to the value of upwards of £33,500,000. Both in New Zealand and in New South Wales there are mines of excellent coal believed to be practically inexhaustible, which will prove of infinitely greater service to those colonies than their auriferous deposits. About a third of the volume is given to the islands of the Eastern Archipelago and Japan, of which clear a account is supplied both as regards their natural and their political aspects.

*The Year Book of Facts in Science and the Arts.* By James Mason. London: Ward, Lock and Co.

THE volume for 1879 of this well-established annual is, as usual, compiled with judgment, scarcely any discovery of importance made or announced during the year having been overlooked, while the space devoted to each is almost always in accordance with its actual value. The system of classification employed is at once simple and comprehensive, and the reader is thus enabled to see clearly the great advances that have been made during the year the book covers, in almost every department of knowledge.

### NEW BOOKS.

Appendix, Telegraph Code (The). Compiled by H. R. Meyer. 8vo. Hamilton and Co.

House Architecture. By J. J. Stevenson. Illustrated. Royal 8vo. Macmillan and Co.

Light Science for Leisure Hours. By R. A. Proctor. First Series. Fourth Edition. Crown 8vo. Longmans and Co.

Mathieson's Map of the Railway Systems in England and Scotland. Corrected to January 1st, 1880. On Sheet, in Case, and on Rollers. Stanford.

Principles of Agriculture. By S. Tomlinson. 12mo. Simpkin and Co.

Proceedings of the Association of Municipal and Sanitary Engineers. Vol. V. 8vo. Spon.

Steel: its History, Manufacture, Properties and Uses. By J. S. Jeans. 8vo. Spon.

### BOOKS RECEIVED.

Acoustics, Light and Heat. By Thomas W. Piper. London: G. Philip and Son.

Easy Lessons in Light. By Mrs. W. Awdry. London: Macmillan and Co.

Proceedings of the Association of Municipal and Sanitary Engineers and Surveyors, Vol. V., 1878-79. London: E. and F. N. Spon.

Woodworking Machinery: its Rise, Progress and Construction. By M. Powis Bale. London: Crosby Lockwood and Co.

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## TO READERS AND CORRESPONDENTS.

CANVAS FIRE HOSE.—Referring to the article upon this subject, which appeared in our last issue, Messrs. Anderson, Abbott and Anderson, of Victoria Buildings, Queen Victoria Street, London, write us to say that the hose mentioned by us as having been submitted to a public test was not the manufacture of Messrs. Davis and Henwood, but was supplied by Messrs. Anderson, they having the sole right of sale of the patented article in England. They further refer us to the case of Anderson and Company *v.* Davis and Company, which was heard before the Master of the Rolls on Wednesday last, a report of which will be found in our present issue under the head of Legal Intelligence.

## OBITUARY.

MAJOR M. LAMBERT, instructor in surveying at the School of Military Engineering, Chatham, died very suddenly on Friday last week. The deceased only proceeded to Shoeburyness a few days ago on leave of absence. The appointment of instructor in surveying, which thus becomes vacant, is worth £650 per annum.

WE have to announce the death on Friday last week, at Leamington, of Mr. Robert Baker, C.B., formerly one of the chief inspectors of factories, in his 77th year. Mr. Baker began life as a member of the medical profession, and devoted great attention to the condition of the factory operatives. In 1834 he was appointed sub-inspector of factories under the Factory Act, and in 1858 was made one of the chief inspectors. On his retirement he was created C.B of the Civil Division.

GENERAL MORIN, director of the Conservatoire des Arts et Métiers, died on Saturday, at the age of 85. On quitting the army in 1835 he became first professor of mechanics and afterwards director at the Conservatoire. He published a treatise on practical mechanics, and invented several instruments, such as the rotatory dynamometer, the dynamometric handle, and the Morin machine for demonstrating the laws of movement of heavy bodies.

M. SALACROUF, the manager of the Orleans Railway, died last Sunday at the age of 59. He was one of the last survivors of the group of men—Talabot, Bartholony, Pereire, &c.—to whom France is indebted for her network of railways. At 25 he became an ordinary engineer to the Centre Company, soon became engineer-in-chief, and in 1852 took the management of the Orleans line. The financial embarrassments of that undertaking, which is about to be wholly or partially bought up by the State, are believed to have hastened his end, though he was in no way responsible for them.

MR. NATHAN ROWLAND, of the firm of Rowland and Co., iron and steel manufacturers, Philadelphia, died on the 24th ult. Mr. Rowland was born in 1809, at Oxford, near Philadelphia, and at a very early age entered the iron business with his father, Maxwell Rowland. Since 1845, in connection with his brother James, he has carried on the Kensington Iron and Steel Works. He was a lineal descendant of John Rowland, who came to Philadelphia in the year 1682 with William Penn. He was a man of strict business habits, perfect integrity, and of an exceedingly kind, though somewhat retiring disposition.

## FACTORY NOTES.

REMOVAL.—Messrs. T. B. Jordan, Son and Meihé, engineers and contractors, have removed their offices from Queen Victoria Street to Adelaide Chambers, 52, Gracechurch Street.

THE BOCHUM STEELWORKS.—The Bochum Company have appointed Mr. Paul Gutike, of 44, King William Street, E.C., the agent for the sale of the various productions of their steelworks in Great Britain.

FAILURE.—Messrs. Samuel Turner and Son, button manufacturers, of Old Meeting Street, Birmingham, have filed a petition for liquidation in the Birmingham Bankruptcy Court, with liabilities estimated at £18,000, and assets not yet ascertained.

THOMAS HARRISON AND COMPANY (LIMITED).—This company, which was formed in 1875, with a nominal capital of £50,000 in £10 shares, to carry on an established engineers' and ironfoundry business in Dale Street, Liverpool, was on the 7th of June last year ordered to be wound up. On Monday, upon the application of the liquidator, Vice-Chancellor Little, sitting at his chambers in Stone Buildings, Lincoln's Inn, sanctioned the sale of the goodwill and stock-in-trade for £4392.

HILTON HOUSE AND RED MOSS COLLIERY COMPANY.—Vice-Chancellor Little, at his chambers, Stone Buildings, Lincoln's Inn, made, on Monday, upon a creditor's petition, an order to continue the voluntary winding-up of this company under the supervision of the court. The voluntary liquidator expressing, by counsel, his desire to be discharged from his office, his Honour directed a reference to the district registrar for the appointment of a liquidator in his place.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending February 7th. On Monday, Tuesday and Saturday (free) from 10 a.m. to 10 p.m., Museum, 7496; Mercantile Marine, Building Materials and other collections, 1106. On Wednesday, Thursday and Friday (admission 6d.) from 10 a.m. till 4 p.m., Museum, 1285, Mercantile Marine, Building Materials and other Collections, 48. Total, 9935. Average of corresponding week in former years, 14,267. Total from the opening of the Museum, 18,693,264.

COTTON MACHINE BELTING.—Travellers in Sweden visiting industrial establishments will probably have seen the "Bomulls Drifremmar," or Scandinavia patent cotton machine belting, at work there. This belting is well known in that country where it has been in satisfactory use for three years, its economy being one of its great merits. This belting is now being introduced into this country by Mr. W. Willson Cobbett, of 60, Queen Victoria Street, London, and to whom users of machine belting will have to be indebted for a really economical machine belt.

PATENT NUT AND BOLT COMPANY.—The directors of this company, in their report for the past year, announce a net profit of £36,217 19s. 9d., and adding to the balance brought forward from last year, of £3409 0s. 11d., a deferable surplus is given of £39,627 0s. 8d. The directors propose to appropriate this as follows:—To pay a dividend of 10 per cent. for the year (amounting to £28,000., £7000 of which have already been paid *ad interim*), to place £5000 to the reserve fund, and to carry a balance of £6627 0s. 8d. forward to next year's account.

THE IRON TRADE AND THE WEIGHTS AND MEASURES ACT.—Mr. J. G. Horder, the inspector of weights and measures for the South Staffordshire district, has issued a circular letter calling attention to the fact that many firms in the iron trade have not yet provided weights of legal standards. These latter must be substituted for lumps of iron and weights of 112 lb. and 120 lb. (long weight). The highest legal standard is 56 lb., and he states that his duties render it imperative for him to take legal proceedings against numerous iron manufacturers who will keep illegal weights.

PRIVATE BILLS IN THE SESSION OF 1880.—The report of the Board of Trade upon all the railway, canal, tramway, gas and water Bills of the session 1880, issued this week as a Parliamentary paper, shows that the total number of such Bills is 172. The number of Bills relating to railways and canals is 100, by which it is proposed to open up 636 miles for traffic, and to raise capital amounting to £20,073,490. Fifty-nine of the Bills are promoted by existing companies, and forty-one by new companies. The tramway Bills, twenty-five in number, propose to lay down 124 miles of rail at a cost of £1,468,300. The number of Bills relating to the supply of gas is twenty-seven, and to water supply twenty. The capital proposed to be raised by the gas Bills is £4,416,250, and by the water Bills £5,084,900.

THE LONDON COAL SUPPLY.—The official statement of the import of coal into London shows that during January there were brought by 525 vessels 384,710 tons, and by railway and canal 575,905 tons. Newcastle, Sunderland, and Hartlepool were the largest contributors to the tonnage of seaborne coal; whilst the Midland, the London and North-Western, the Great Western, the Great Northern, and the Great Eastern, were, in order stated, the chief contributors to the carriage of coal by railway. The coals brought into the metropolitan district by sea show an increase of 48,214 tons over the quantity for the corresponding month of last year, and the supply of railway-borne coal is increased also by 29,175 tons. Out of the quantities brought into the district, 214,045 tons were exported again to other places; but after allowing for the difference between this quantity and that for January last year, the total consumption of coal in the metropolis seems to have been 78,061 tons more than in the corresponding month of last year.

THE MIDDLESBOROUGH WATERWORKS DISPUTE.—The dissatisfied customers of the Stockton and Middlesborough Water Board brought their grievances before the Board on Monday. They asked for the appointment of an umpire to take evidence and decide upon the matter in dispute, namely, whether or not the meters had been tampered with by the Board's officials so as to cause them to register a larger quantity of water than had actually passed through them, setting them, in fact, to what the Board and their officials conjectured they ought to have indicated. The answer of the Board was that they were always ready to entertain and thoroughly sift any complaint of a tangible nature; but, as in this instance no specific charge or allegation was made, the Board did not see their way to appoint an umpire, more especially as it was proposed that the umpire be asked to say whether mere suspicions were groundless or not. The petitioners will meet again shortly to decide what course to pursue; and it is not improbable that the question may come before the law-courts.

THE CHARLTON IRONWORKS COMPANY (LIMITED.)—A meeting of the shareholders of the Charlton Ironworks Company (Limited), was held at the Cutler's Hall, Sheffield, on Wednesday. There was a large attendence, and the chair was taken by Mr. Joseph Garside, of Worksop, the official liquidator. Mr. Garside gave a very encouraging statement of the present prospects of the company as compared with what they were before the present cheering symptoms in the iron trade were visible. After considerable conversation, a resolution was passed empowering Mr. Garside to apply to the Court of Chancery for leave to sell the property at such a price as should not be less than sufficient to clear the company's liabilities, which are estimated at £20,000. A further resolution was carried to the effect that a committee should be appointed, consisting of shareholders having not less than twenty shares, to consider the desirability of forming a new company to purchase the company's works or any part thereof with a view to their resuscitation. The Charlton Ironworks Company (Limited) was registered in 1872, and the paid-up capital is £105,000 in £50 shares. After the company went into liquidation the property, of course, depreciated to an immense extent; the amount of depreciation being stated at the end of last year as £97,000, leaving only £8000 of the original capital to the good. Since that time a considerable improvement has taken place, and the shares are now quoted on 'Change at about £6 each.

THE FACTORIES REPORT.—The first annual report of Mr. Redgrave, the chief inspector of factories has just been presented to Parliament. Referring to the state of trade, Mr. Redgrave remarks that if the report had been commenced three months earlier than the 1st of December, he would have had to present a very different picture from that he is now, happily, able to present. It is painful to realise, from the constant communications from manufacturing districts, the want of employment. Every industry has suffered in a manner unexampled. Mr. Redgrave then quotes the reports of district inspectors. Sir Wm. Chaytor, inspector for the North of England, says that in his district, though the trades have been long depressed, the iron and chemical trades have lately improved. The shipyards are not very busy, though some have recently got orders. Mr. Coles, Manchester, says that the iron trade has wonderfully improved, owing to the trade revival in America. Mr. Henderson, Scotland, reports very hopefully. In the last three months there has been a marked revival of industry. Several of the largest shipbuilding yards of Glasgow have eighteen months' work. He rebuts the opinion that the improvement is the result of speculation only, and says there is no cause to apprehend a serious reaction. He remarks, however, that the further removed manufacture is from the raw material, and the more labour is bestowed upon production, the less has it shared the general improvement. Hence many complaints of dulness. Numerous other reports are quoted, much to the same effect. Towards the conclusion, Mr. Redgrave discusses the proposal that practical working men and women should be appointed inspectors. He points out many objections to the plan, and thinks the proposers have failed to clearly appreciate the exact nature of the duties of factory inspectors.

THE RATING OF MACHINERY.—The unsatisfactory condition of the law with regard to the rating of machinery has long been a subject which has occupied the attention of the owners and occupiers of factories and workshops throughout the kingdom. As the law at present stands, at the close of each session of Parliament, an Act is passed for the exemption of stock-in-trade from liability to be rated for the relief of the poor, but by the decision of the Court of Queen's Bench, in the appeal case of "Laing against The Owners of Bishopwearmouth, and the Assessment Committtee of the Sunderland Union," given in 1878, it was practically determined that machinery essentially necessary for the carrying on of any particular business is liable to be rated. This decision, it is naturally felt, leaves the question of rating liable to a much more extended application than has hitherto been contemplated, and that machinery "essentially necessary" to the carrying on of a business might be held to include all kinds of machines which are now exempted from rating. For instance, if the principle is to be carried out it might be asked what would constitute the technical difference between tools and machines, or if machines are rateable there would seem to be no valid reason why tools should not be rated also; and to go further, it would be difficult to avoid the conclusion that if machinery in mills and factories is to be rated, that threshing and other machines used by farmers upon the land must be likewise rated, such machines being equally necessary to the farming business. It has consequently been considered necessary by the owners and occupiers of factories and workshops affected by this enlargement of the area of rating which the judgment undoubtedly legalises that some action should be taken to secure a permanent and intelligible settlement of the question, and a National Association of Occupiers of Factories and Workshops in Great Britain and Ireland has been formed in Manchester, by whom it has been decided, to introduce during the present session of Parliament, a temporary Bill for dealing with the matter. In practice the assessment of factories and workshops has not hitherto gone, except in the case of some descriptions of heavy machinery, beyond the driving power, such as boilers, engines and main gearing, and it is urged by the Association that the only true principle to be observed in determining the question is that "the driving power" should be held to be rateable property, and that "the thing driven," by whatever name it may be designated, should be exempt. It is upon these lines that the proposed Bill, which is entitled "An Act to exempt, until the 31st day of December, 1881, occupiers of property from liability to be rated to the relief of the poor and other local rates, in respect of machines, other than machines used solely for the purpose of creating and transmitting motive power to other machines," is drawn up. After referring to the Act 43rd Elizabeth "For the relief of the poor," and to the Act 13th and 14th Charles II., "For the better relief of the poor of this kingdom," the Bill proceeds that, "whereas, by reason of the provisions of the said Acts, it has been held that machinery and plant essentially necessary to a business, and permanently attached to the business, is to be taken into consideration in estimating the rateable value of the premises in which the business is carried on, and it is expedient to amend the law in this respect. Be it therefore enacted by the Queen's Most Excellent Majesty, and by the consent of the Lords Spiritual and Temporal and Commons in this Parliament assembled, and by the authority of the same, as follows:—(1) From and after the passing of this Act, the rateable value of any tenement for the purpose of assessment to the poor rate, county rate, borough rate, or other local rate, leviable upon property rateable to the relief of the poor, shall not include the annual value of any machinery used in any trade, manufacture or business carried on in such tenement, except machinery fixed to the freehold, and used in such tenement solely for the purpose of creating motive power and transmitting such power to machines in the same or any other tenement. (2) This Act shall be in force till the 31st day of December, 1881, and from the said 31st day of December this Act, and the provisions thereof, shall absolutely cease and be of no effect." The question has also been brought under the consideration of employers in the engineering, iron and other trades, and there is no doubt that the action taken by the National Association of Occupiers of Factories and Workshops will receive the support of the Iron Trades Employers Association.

## THE TRADE REVIVAL.

THE revival of the iron trade has led to a great extension of iron making plant as well as increased the value of existing works, and the improvement is still proceeding. The increase in the value of shares in the iron and steel companies of Sheffield has been very great within the past two months, the rise in the market value being over £1,000,000. The shares of Messrs. John Brown and Co. (Limited) have risen in value since December 1st, £101,250; Messrs. Cammell and Co., £60,000; Messrs. W. Jessop and Sons (Limited), £34,113; Earle's Shipbuilding Company, £39,000; Davy Brothers (Limited), £750; W. Cooke and Co. (Limited), £28,000; Sheepbridge Canal and Iron Company (Limited), £78,750; Staveley Coal and Iron Company, A shares £31,500, B shares £5040, C shares £33,000, D shares £3487; Parkgate Iron Company, £63,000; Andrew Knowles and Sons (Limited,) £68,750; the Bilbao Iron Ore Company (Limited), £101,250. The increase in the value of the shares of Messrs. Bolckow, Vaughan, and Co. in the same period is no less than £418,750.

The directors of John Bagnall, Sons and Co. (Limited), in their report for the past year, state that the gross profits on the operations at their ironworks and collieries amount to £4,054 6s. 8d. From this the sum of £1,849, 8s. 9d. has been deducted for debenture loan, leaving the net profit at £2,204 17s. 11d., which will be appropriated to the reduction of the debt incurred by previous losses, and therefore no dividend will be declared. Their Capponfield furnaces have been let, and the Gold's Hill furnaces are producing pig-iron for their own finished ironworks. The debenture loan account has been reduced by £50,000, and the rate of interest from 5 to 4½ per cent., and the latter is to be further reduced to 4 per cent. when another £10,000 has been paid.

At the recent meeting of the Cleveland Association of Engineers, Mr. Edward Williams announced that some extensive additions were about to be made to the steel-making plant of Messrs. Bolckow, Vaughan and Co. at their Eston works. The steel plant of Messrs. Bolckow, Vaughan and Co. at Eston, is to be so far added to that the present size of the works will be almost doubled. The plant originally cost some £300,000, and is understood to be one of the largest steel-making concerns in the world, being also fitted up in such a manner that manual labour is to a very great extent practically dispensed with. The proposed additions will be to the mills, which are to be extended to twice their present capacity. The alterations, upon which draughtsmen and engineers are already busy preparing plans and making out estimates, will cost the sum of about £150,000. These works since their commencement have been turning out an average of something like 2000 tons of steel rails per week, which are shipped from the Tees to all parts of the world. The new extensions will doubtless require more furnace power, but this will be supplied from the iron furnaces already in existence near the mills. In addition to this extension, Messrs. Bolckow, Vaughan and Co. are at present putting down at great cost two new converters at an original design for making steel from the local ores. The dividends paid by this concern since it was converted into a limited liability company in 1865 have been as follows:—1866, 10 per cent.; 1867, 10 per cent.; 1868, 10 per cent.; 1869, 13½ per cent.; 1870, 16¾ per cent.; 1871, 10 per cent.; 1872, 15 per cent.; 1873, 21½ per cent.; 1874, 12½ per cent.; 1875, 8¾ per cent.; 1876, 7½ per cent.; 1877, 6 per cent.; 1878, 5 per cent.

A remarkable event in the history of a commercial undertaking has just occurred. Hopkins, Gilkes and Co. (Limited), of Middlesborough, was ordered to be wound up last May. Since then, however, in consequence of the revival of trade, the shareholders have found they can go on with their works with profit. On the 3rd inst. a meeting was held, at which a resolution in favour of a scheme for reconstructing the company was confirmed, and the Master of the Rolls has been applied to for an order to stay all the proceedings in the liquidation, if the scheme was given effect to. It was stated that the creditors would be paid 20s. in the pound. The Master of the Rolls granted the application.

Mr. H. O. Firmstone has reopened the Hyde Works, Kinver, near Wolverhampton, which were carried on for many years by Messrs. Lee and Bolton. The Cyclops Ironworks, Walsall, carried on for many years by the late Mr. E. Russell, have been sold for £7780.

On Tuesday, in the Board-room of the Royal Exchange, Middlesborough, the Norton Ironworks were offered for sale by public auction by Mr. Charles Willman. There was only a small company present. The blast-furnaces—six in number, but three of them small and rather antiquated—with the chair foundry and a lot of freehold land were first offered, and the auctioneer at once named the upset price put upon these by the Court, viz., £45,000, but no one made any bid either of this or any higher amount, and consequently the lot was withdrawn, as was also lot 2, consisting of two water corn mills.

The Slapewath Ironstone Mines, near Guisborough, which were offered for sale by auction some three weeks ago, have been purchased privately by Messrs. B. Samuelson and Co., of the Newport Ironworks, Middlesborough, who will put them in operation as soon as possible.

The work of repairing the Ellen Rolling Mills, at Maryport, and of adapting them to the present requirements of trade, is progressing favourably, and it is anticipated they will be ready to commence work under the management of Messrs. Kirk Brothers in a few weeks. A very marked impetus has been given to the finished-iron trade of Cumberland, and makers are extending their works in all directions to facilitate the output. Most makers of steel in North Lancashire and Cumberland are experimenting with a view to commencing the manufacture of Siemens-Martin steel, for which the hematite iron found in this district is particularly adaptable.

Upwards of £20,000 has already been subscribed towards the new Whitehaven Shipbuilding Company, which it is proposed shall buy up the yard and plant of the old company now in liquidation.

## THE LABOUR MARKET.

ON Monday the mechanics in the railway works of the London and North-Western Company at Crewe, to the number of 5000, resumed work on full time. Two years ago the men were offered the alternative of submitting either to short time or a reduction of their numbers, and they chose the former. For some time the prospects of the company have been improving, and the directors feel themselves in a position to put their Crewe works on full time, concurrently with the declaration of a dividend of 7½ per cent. The furnacemen, numbering about sixty, employed by the Denby Ironworks Company, having demanded either an advance of wages or a decrease in their working hours, have obtained the former. They are to have an advance of 5 per cent., and should trade go on improving as it does at present, they are to have another 5 per cent. in March. On Tuesday afternoon Mr. M'Williams and a deputation of workmen waited on Mr. Jenkins, general manager of the Consett Ironworks, with a view to a settlement of the dispute between the company and their blast-furnace men. Last week the company, who have put an additional tram incline to their blast-furnaces, attempted to reduce the number of hands, but the men objected, and struck work. About thirty of the men were served with notices of dismissal, whereupon the rest—upwards of two hundred—gave in their notices. It was agreed to withdraw the notices on both sides, and attempt to settle the dispute in an amicable way if possible. Throughout the South Staffordshire and Worcestershire districts the horse-nail makers gave notice on Saturday for an advance of 3d. per 1000 in wages. In the event of the advance not being granted it is expected a general strike will take place. The Brazil nail makers have also given notice for an advance of 3d. per 1000. It has been decided by the proprietors of the principal forges where merchant iron is manufactured in Leeds to accede to the demand of their puddlers and millmen for an advance equivalent to 10 per cent. These two classes of hands had their wages increased 5 per cent. in December. This last advance, which takes effect immediately, is based upon an award made about a month ago by Mr. Chamberlain, M.P., acting as arbitrator for the South Staffordshire puddlers and rollers. The two cases of lock-out at Barrow affecting shipbuilders and steel makers have terminated satisfactorily by a compromise, the men having returned to work. On Friday last week a number of the men employed at the Stanhope Silkstone Colliery, near Barnsley, which since the 1st of September last has been worked by Messrs. Haworth, of Liverpool, received 14 days' notice to quit their employment. The owners employ about 170 men, and it is understood to be their intention to reduce the number by 40 or 50 on account of the quiet state of the house-coal trade and the low prices which prevail, especially as regards the London trade, with which the colliery is largely connected. The sliding scale between the Northumberland coalowners and their enginemen has been agreed to. The arrangement is to continue for one year, subject to a month's notice, and the changes, if any, are to be made at the first pay in January, April, July, and October. There is to be no maximum and no minimum, but when the average selling price of all coal raised is that of November, 1878, the wage to be that at present paid. When the price rises a full 4d. above this, 2½ per cent. advance; when the price falls a full 4d. below this, 2½ per cent. reduction; for each complete 4d. per ton fall 2½ per cent. reduction, and for each complete 4d. advance on the following scale:—Up to 6s. 4d., 2½ per cent. for every complete 4d.; at 6s. 4d. 5 per cent. for every complete 4d.; from 6s. 4d. to 8s., 2½ per cent. for every 4d.; and at 8s., 5 per cent. for every 4d., and so on, every 1s. 4d. carrying an extra 2½ per cent. After negotiations, extending over four months, the coal owners and miners in South Yorkshire have adopted a sliding scale for the future regulation of wages. This decision was arrived at after a protracted interview, which was held at Sheffield, between a deputation of coal owners and a deputation representing both the miners' associations. The sliding scale is to be in operation for two years. It commences with the selling price of coal at 5s. 3d. per ton, this being the price at which, it is said, to be now selling at the pits. At a meeting of the Executive Board of the Fife and Clackmannan Miners' Association, held at Dunfermline, on Saturday, it was agreed that in consequence of the action of the coalmasters steps should be taken to induce the men to leave the two counties to the number of at least 2000, and that at no colliery should the men work more than eleven days per fortnight.

## LEGAL INTELLIGENCE.

### HIGH COURT OF JUSTICE.

### CHANCERY DIVISION.

(Before the MASTER of the ROLLS.)

ANDERSON AND CO. V. DAVIS AND CO.—Mr. Whitehorne moved, on behalf of Messrs. Anderson, Abbott and Anderson, and Mr. Pabeaux, to restrain Messrs. Davis and Henwood from issuing or distributing circulars in which they claim to be manufacturers of "The Patent Canvas Fire Hose." Mr. Pabeaux, who carried on business in Belgium, had patented in England a fire hose composed of webbing and indiarubber, the only portion of the invention that was new being the method of strengthening the seam, and Messrs. Anderson and Co. had the exclusive right of selling the hose in this country. In December a trial of the plaintiff's hose was made by the Metropolitan Fire Brigade, and Captain Shaw was so impressed with its excellence that he ordered it to be adopted by the Brigade. The trial was attended by the Press, and spoken of in favourable terms in several journals. The defendants, who were rival manufacturers, had issued circulars headed "The Patent Fire Hose," which embodied a garbled account of the reports from the newspapers, and which was calculated to lead the public to believe that the defendants were the manufacturers of the hose approved of and adopted by the Metropolitan Fire Brigade. The case of the defendants, for whom Mr. Ince, Q.C., and Mr. B. B. Rogers appeared, was that the plaintiffs had no right to claim the invention as new, and the reason they had published the circulars was in order to correct the impression which the newspaper reports had created in the public mind. The Master of the Rolls held that the circulars were calculated to induce the public to believe that the defendants really were the manufacturers of the hose adopted by the Metropolitan Fire Brigade, and therefore granted the injunction in the terms asked.

## IRON AND COAL TRADE REPORTS.

**BARNSLEY AND SOUTH YORKSHIRE.**—The most experienced amongst the coalowners of this district are just now seriously perplexed with respect to the position of the house-coal trade. At no previous period in the history of the district was the trade in a more critical state. If anything, there has been a falling off in the demand during the week, whilst prices are lower. Advices received from London colliery agents report that on the Coal Exchange on Monday last offers were made on the part of a large limited colliery company working the Silkstone seam to supply house-coal in waggons at the pit at 7s. per ton, the waggon hire charged by the Great Northern being 1s. per ton. On the other hand, one of the largest house-coal collieries working the Barnsley bed in the best part of the seam are advertising in a Spalding paper their best house-coal at 15s. 6d., and seconds at 13s. 6d. per ton, with 1s. extra for delivery. The tonnage rate from South Yorkshire to Spalding is 7s. 4d., to which has to be added 2s. for waggon hire and other charges, so that some idea may be formed of the sad state of trade in this district. The tonnage sent to London is only moderate, whilst the business passing with the eastern counties is very quiet and unprofitable. There is, however, on the other hand, a good demand for steam-coal, and that at a season of the year when it is usually quiet. A good deal is, however, required for smelting purposes, so that prices are rather stiffer. Engine coal and fuel is in moderate request, and rather better prices are being realised. The only redeeming feature of the coal trade is the business doing in coke, which not only consumes the small coal, but realises a fair profit. There is a large and increasing demand for North Lincolnshire, into which district not only South Yorkshire, but North of England makers are pouring large quantities daily. The ovens at Silkstone Common, now leased by the Hoyland Silkstone Colliery Company, are in full work, and are supplying the furnaces at Milton and Elsecar with a first-class quality of coke. The district has at last secured a sliding-scale, but whether all the owners will conform to it remains to be seen. The question of removing the headquarters of the South Yorkshire Coalowners' Association to Barnsley from Sheffield has recently been discussed, and seeing that Barnsley is much more central and more accessible to a larger number of the members, it will probably be adopted. The Monk Bretton men are still out, but the colliery is being worked by new hands. The miners employed at the Barrow collieries brought out their tools on Wednesday, because the owners would not concede the full ten per cent. which they deducted in September last. The iron trade shows very little alteration. As a rule, the foundries are beginning to exhibit greater animation. There is a large output of pig-iron from the various furnaces at work. The production of Bessemer steel rails, tuyers, &c., is fully an average one, the works in the district being kept fully going. Puddlers and workmen employed in the make of merchant and other kinds of manufactured iron, are better employed than they were a few months ago.

**BIRMINGHAM.**—The aspect of affairs just at the present moment in the local and district hardware trades generally is even less satisfactory than last week, and in a very considerable number of branches there is a chorus of complaint on the part of manufacturers as to a virtual stagnation of trade. It is true that, so far as the heavier industries are concerned, most firms being well under order, are fairly employed, and that, in some of these, new orders of limited extent are coming to hand, chiefly for export. In other branches, however, in which copper, brass and tin enter largely into the raw material used, the heavy upward movement in the metal markets, the influence of which it was noted last week had already begun to be felt, has produced a temporary paralysis of trade. Buyers steadily decline, in the face of only a very moderate consumptive demand, to give the advanced prices which the rise in metals has compelled manufacturers to ask; and there is certainly nothing in the aspect of the market to induce makers to book orders at anything under current quotations. The result is that a good many firms, to keep their hands in anything like full employment, are compelled to work for stock, a condition of things which augurs but indifferently for the permanence of the trade revival which has recently set in. The export trade presents a somewhat better aspect than the home trade. A slight improvement has exhibited itself in advances from the Australian colonies, but in this quarter business is still a very long way below the average. In the New Zealand markets, on the contrary, more animation is shown, owing to the plentiful harvest, and some fair orders have recently come to hand. Monday's West Indian mail brought a better supply of orders from Brazil and some of the South American markets considerably in advance both as to quantity and value of recent advices. Chili, notwithstanding the adverse influences of the war with Peru, is taking some very fair consignments of galvanised iron goods, edge-tools, tinware &c. From Russia and the United States the local steel toymakers have had a few orders of late, and a trade is gradually being opened with the European provinces recently freed from Turkish rule. There is a fair demand for locks from Canada and the States, but the Indian trade in this branch has fallen off considerably. The home trade is very dull for the season, retailers evincing a determination not to concede the enhanced prices demanded for finished goods, although they are not indisposed to buy heavier articles where they can be obtained on terms somewhat more favourable than current quotations. What little animation exists is reported to be wholly confined to the metropolis and the densely populated manufacturing towns in the provinces. Business in the agricultural districts being restricted within such narrow limits as to be practically of no importance in estimating the volume of trade. In the chandelier trade the slight revival which had begun to manifest itself, has been apparently nipped in the bud, by the advances in metal, and, with the exception of a few export orders of no great extent, manufacturers report that nothing is coming to hand. In the iron trade matters have remained during the week in much the same position. The heavy demand from the United States suffices to keep the market strong, notwithstanding the sales recently effected by middlemen, and there are signs on all hands of preparations to increase production. At Herberts Park Works, Darlaston, where one furnace was blown-in a few weeks since, another is shortly to be put in blast, and there are rumours that several others will shortly be blown-in in the district. The Cyclops Ironworks, Walsall, which has been closed since the death of the late Mr. E. Russell, have just been sold to Mr. Walter Jones, acting as the agent of undisclosed purchasers, for £7780, namely, £6000 for the works and £1780 for duplicate rolls. There appears to be every probability that an arrangement will be satisfactorily arrived at between the ironworkers of the district and the ironmasters, with reference to the adoption of a wages sliding scale as proposed, from and after the 1st of April next. The Bilston operatives on Monday passed a resolution affirming the principles of the scale as prepared by the operative representatives on the Wages Board. On the Wolverhampton market on Wednesday no change was made in the market quotations, but there was manifest indisposition on the part of consumers to purchase at manufacturers' prices. A limited number of orders, chiefly for sheets, rods, and fencing-wire were reported to have come to hand from South America and Australia. Ironmakers were complaining somewhat loudly of the want of specifications for orders already on their books, new business being restricted.

THURSDAY EVENING.—Market to-day fairly steady, with no quotable variation in prices, though middlemen were prepared to accept offers at something under market rates, orders being less plentiful. Hoop and sheet manufacturers have books full for some time forward, and prices in these departments continue very strong. No change in marked iron quotations, although less doing in marked bars. Some makers of unmarked bars are taking orders at a price under the prices they asked a month since. Coal trade quiet, but steady.

**CARDIFF.**—The iron and tin plate works of the district continue to be in full swing. In 1875 the Merthyr Stipendiary characterised the county as appearing recently devastated by an invading army. The flames that are now raging are not destroying but building up villages. One after another, old and liquidating concerns are being started for reproduction. Messrs. S. and W. Booker's works, which went to wreck with the West of England and South Wales Bank, are now doing as much, both at Melingriffith and Longwynlais, as the labour left there will admit of. The Forest Steel and Iron Company, after a long period of poor trading, are beginning to satisfy the shareholders. But, while activity is universal, prices have begun to "hang fire." It would seem as though the most pressing anxieties of consumers have been removed by the closing of contracts; and there is less of a fulcrum for lifting prices. So much, however, has been booked, that it is believed there is food for the works for the rest of the year. The Dowlais Company and the Ebbw Vale Company are understood to have made large contracts with American houses for steel blooms. There are 2000 tons of this article now in process of shipment, and other steamers are expected for further consignments. The American demand for this product is considered as a very hopeful sign, as it is not likely they will be worked up solely for rails. It may be that America may find it most profitable to commence the manufacture of all steel goods at this point; and, where we cannot compete with her in the finished article, half a loaf is better than none. The same holds good with regard to the Bessemer pig. From its proximity to the foreign ores, South Wales should always be able to place the smelted mixture on the States' seaboard on such terms as to prove that the sea and land carriage of foreign ores to the American blast-furnaces is a blunder. The coal trade continues to share the better condition of things, and the coke-makers are sanguine that, notwithstanding competition from Durham and the North, some shillings more will be realised. A difficulty is reported in getting ore at Bilboa, and freights have fallen again. The Admiralty tenders have been adjudicated, and about 90,000 tons booked for delivery to the home and foreign depots. It would work more beneficially for the Government if they would buy f.o.b. and accept current freights. In consequence of their terms, certain well-known firms never tender for the foreign depots; and the business gets gradually into fewer hands—those who have been bit severely by jumping freights retiring from the risk, or seeming to get established in the favour of the Admiralty by reason of their sacrifices. Thus it is getting more and more the rule that for certain depots certain coals are inevitably supplied. There has been jubilation among some eminent coal-factors who had large commitments in Egypt. After apparently irretrievable delays occurring subsequent to proof and admission of their claims, payment has at last been made. This news does not add to the satisfaction of certain other creditors, whose claims are equally good and proven, but whose many thousands of pounds have been accidentally overlooked. The railway companies have been taxed to their utmost extent to cope with the increased traffic of the district, and the engine-drivers have been granted bonuses. The Rhymney Railway Company, which for many a long year paid the original shareholders nothing per cent., and which only began to divide anything three years ago, has this year surprised eveybody by declaring ten per cent. —thus, with the exception of the additional two per cent. bonus, equalling the dividend of its older and powerful rival, the Taff Vale Railway. Some exceptionally good traffic management is credited with this result, as the line is not fortunate in the mineral development of its system; but this is improving, and one new large undertaking is expected to become a good and constant feeder by and by.

**CLEVELAND.**—There was an average attendance on 'Change at Middlesborough on Tuesday. The market was firm, with a tendency to rise. Merchants' prices were 61s. for No. 3 immediate delivery, and 65s. over the next three months. Makers were somewhat in advance of these, as they are well sold and full of hope in the future. Forge iron and white have been shipped in unusual quantities to the Continent. This has kept forge still scarce, and abont 2s. in advance of No. 3. Two more furnaces have been blown-in this week at Hopkins, Gilkes and Co.'s works. Other two are being re-lined, and will shortly be in operation. The Lenthorpe blast-furnaces, six in all, are expected to be blown-in by the end of the month. The finished-iron trade continues very busy. Orders are plentiful, and in excess of the power to execute. Plates £9 10s. to £9 15s.; common bars, £8 10s to £8 15s.; angles, £8 15s.; puddled bars, £6 to £6 2s. 6d. Ironfounding is slightly improved, and more orders are being received. Engineering has not been so busy as the other iron industries, but it also is improving. Of the special iron industries the wire works are working fully, and the tube works are so hard pressed that they can with difficulty overtake their orders. The nu,t bolt and rivet works have also had a fair share of work. Manufacturing coals are in good demand. Prices are much the same; steam-coal has advanced slightly in price; coke is in good demand; present delivery 15s., and forward 17s. per ton delivered.

**DERBYSHIRE.**—The iron trade has during the week undergone but little change, the works on the whole being fully employed. There is a very lively demand for pig-iron, which is turned out in large quantities in various parts of the district. The make of gas and water piper pipes is a branch for which certain firms in the district are noted, and this branch is now largely prosecuted. Bessemer steel rails are in pretty good request, as are also other kinds of goods manufactured by that process. The coal trade is not over good, but there is a much better business doing with London than the South Yorkshire coalowners are able to transact. The tonnage by rail is well maintained, considering the competition which has to be met and the low figure at which house-coal is now procurable by merchants in London. There is a fair demand for steam qualities, which are for the most part used for smelting purposes. The coke trade is brisk, and more orders are being called into requisition. After a week's strike the miners employed at the Manor Colliery, Ilkeston, who struck against a dispute about the weight of coal, have returned to work.

**DURHAM.**—The pig-iron trade has revived in tone since last week and prices are about 1s. per ton dearer, for present and even more for immediate delivery. The demand is more active and altogether there is a greater desire to bring forward the consumers who have not as yet secured the iron they want. The makers, however, in the Tee-side district are stiff and do not wish to sell. They only part with iron at considerably enhanced rates, At Witton Park another furnace is going in. This is in the heart of the South Durham district, When this furnace is in there will be four in operation at Witton Park besides all the plate and other manufactured-iron plant of Bolckow, Vaughan and Company at that place. No district in the North of England has seen such a transformation as Witton Park within the last few months. There is not now the same complaint heard of insufficiency of rolling stock to move material on the North-Eastern Railway Company. This company appear on the whole to be able to grapple with the increased traffic from the collieries-ironstone mines, and different works in a very satisfactory way. Their machine and engine works are busy at Sheldon and elsewhere. The Darlington Iron Company are about ready to start their Springfield Works which have been put in order for the purpose and it is averred that arrangements are pending for starting the South Durham blast-furnaces. The manufactured-iron trade has shown no material change. Price are firm at the late quotations. Ship-plates £9 10s., bars £8 10s., angles £8 15s., less the usual commission. Puddled bars £6 2s. 6d. nett. Manufacturing coal is rather dearer. There is more required for various local purposes chiefly for ironworks in Cleveland and Durham. Coke is more settling down in price and there is not such a variation as was sometime since noticed. Present prices are 15s. to 15s. 6d. at the ovens for good quality; 20s. is, however, the figure for the last half of the year.

**FOREST OF DEAN.**—The house-coal industry of this district only commends itself in respect to its continued inactivity, there being no general disposition to reduce prices notwithstanding that week after week orders are withheld on that account. Messrs. Crawshay have reduced prices 6d. per ton, and one of the factors has issued circulars this week offering Foreign coals, best quality, f.o.b. at Lydney, 1s. reduction, viz., 11s. 6d. instead of 12s. 6d. per ton. Until there is a general lower of 1s. very little prospect of improvement is likely to arise. From Wales the chief competition hails, and as that Principality embraces a variety of classes of fuel the Forest is thus disadvantageously placed To-day there is a more gloomy tinge given to trade matters by the temporary stoppage of Messrs. Crawshay's miners, which, apparently owing to an unfavourable reaction in demand for pig-iron, are to be put on short time. This announcement has come like a thunderclap upon the district, and especially so in regard to iron ore miners in question, who only a few days ago posted a notice asking for a ten per cent. advance. From statements made by the men it appears they are 45 per cent. below the rate of 1872-3, when Forest pig-iron had reached the extraordinary figure of £8 5s. as against £6 10s. to £6 15s. at present prevailing. The men have received since November a series of advances making 10 per cent., and they have asked for a similar "rise," which, as alleged, would bring their wage 5 per cent. above the old rate. At least, this is stated in their notice. In justification of Messrs. Crawshay, it is well known that during the long period of low prices, they were carrying on ironmaking at a loss. It is, however, rather remarkable that whilst in other districts industrial prospects are improving, and the iron trade maintains its improved position, this adversity should be apparent in the Forest. Large quantities of the district iron ore are being sent to other localities, and the general condition of mines here is unabated in interest, and it is therefore to be hoped that in the case of Messrs. Crawshay, the reverse of trade may prove only temporary. The tinplate industry, as well as that of the iron wire trade, is strong, and prices continue to strengthen. The recent improvement in steel manufacture by M. Ponsard's converting furnace possesses interest to Dean Forest. Although the method recently made public, is not directly to be introduced at Parkend, it will, as is understood, have an important bearing thereat, inasmuch as the promoters of the new company are directly interested in the Ponsard system, and it is anticipated that in a few days the new company will be registered. Writing later, our correspondent adds that the colliery proprietors are contemplating an immediate reduction of 1s. in house-coals, and 5 per cent. lower in wages.

**GLASGOW.**—The warrant market has fluctuated considerably during the past week, according as the varying reports from America caused buyers or sellers to predominate. A good business has been doing, and holders are sanguine that higher prices must shortly be reached, when the buying sets in for the spring shipments to America. Last week 7460 tons were shipped direct to New York, besides 2542 tons went to Liverpool, largely for transhipment. On Thursday 66s. 6d. to 68s. 6d. cash and 67s. to 69s. a month, were paid, improving next day to 69s. 7½d. cash and 70s. 1½d. a month. On Monday opening strong at 70s. a month and 69s. cash, it quickly fell to 67s. 4½d. cash and 67s. 9d. a month. On Tuesday business was done from 68s. to 69s. 1½d. cash and 68s. 4½d. to 69s. 6d. a month. On Wednesday from 68s. 3d. to 68s. 9d. cash and 69s. a month was paid. Closing quieter. Sellers 68s. 4½d. cash and 68s. 4d. a month, buyers 1½ per ton less. Makers' prices are firmer than last week, and several good sales have been effected. The makers, having confidence in the future, are still increasing the production, and there are now 111 furnaces in blast. The shipments of pig-iron from Scotland last week were:—Foreign 9385 tons, coastwise 4765 tons, total 14,150 tons, against 6139 tons in the corresponding period of last year. The imports of Middlesborough pig-iron into Grangemouth last week were 4140 tons, against 7096 tons in the similar period of last year. The total imports till February 7th, 1880, are 41,535 tons, against 25,109 tons till February 8th, 1879, showing an increase for this year of 16,426 tons. The stock in Connal and Co.'s store continues to increase daily, the amount there being now 439,942 tons, an increase since last week of 2706 tons. The works in the manufactured-iron trade are busily employed on old orders, and prices are firmly maintained, though comparatively few new orders are coming to hand, and middlemen are willing to sell considerably under makers' quotations. It is reported that the Carntyne Rolling Mills and the Coats Ironworks Coatbridge are to be set agoing by local firms. The exports from Glasgow last week were large, and include for India wrought iron valued at £13,549, sewing machines for the Continent at £6519, wrought iron for Palermo valued at £3190, machinery for South America at £8351, wrought iron at £3535 and cast-iron sleepers at £2262. The shipbuilding yards are well employed, and extra workmen are being employed for the purpose of hurrying on the orders on hand. The engineers and founders are doing a quiet trade, and the locomotive builders are very busy. The coal trade is rather dull shipping orders are scarce, the colliers are working more steadily at the advanced wages.

**LANCASHIRE.**—A limited amount of activity is still reported in the iron trade of this district, and although there was a full attendance at the Manchester weekly meeting on Tuesday, the amount of business doing was not large. There is, however, still a fair inquiry for shipment, considerable orders every now and then coming into the market, with a good deal of iron still to deliver on foreign account, and although merchants and dealers, influenced by the temporary lull in the market, have in many cases shown an anxiety to realise at under late rates, makers, as a rule, continue very firm. Indeed, there is very little makers' iron offering in the market, except for forward delivery, for which very high prices are asked, and consequently, merchants, some of whom hold a good deal of iron, have been taking a good deal of the business which has been done of late. Lancashire makers of pig-iron are pressed for forge qualities, but, with the exception of some of the lower numbers, they have at present little or nothing to sell; foundry iron, however, for which they could book orders, is difficult to move. For delivery into the Manchester district their quotations remain at about 70s. per ton less 2½ per cent. In outside brands there is no very material change, makers asking about late rates while merchants have been underselling rather. In Lincolnshire iron delivered into the Manchester district about 75s 6d. per ton less 2½ per cent. is asked, but second-hand lots have been offered as low as 70s. for prompt delivery; for North-country iron, delivered equal to Manchester, about 70s. per ton net cash is asked, although sellers at under this are reported, but for forward delivery about 13s. 4d. per ton net cash is quoted. Second-hand lots of hematite have been sold during the past week for delivery equal to Manchester at about £7 per ton. In the finished-iron trade makers generally are still so full of orders that they do not care to quote at present, and most of the sales now being made are through merchants. It is difficult to get at any really fixed price; those asked by makers are in many cases altogether out of the market, and dealers' prices vary a good deal according to circumstances. For puddled bars delivered into the Manchester district £6 10s. to £6 15s. per ton is asked; for ordinary Lancashire bars, £9 to £9 10s.; and for hoops about £10 10s. per ton. In the foundry trade there seems to be rather more doing although the small firms still complain; engineers and machinists report more enquiries and boiler makers are busier. The coal trade continues generally dull. The demand for house-fire coal is rapidly falling off, and many of the best coal collieries are now being put on short time, whilst heavy winter stocks are still left on hand. Common classes of round coal for furnace and iron making purposes are in fair demand, but supplies are more than sufficient to meet requirements. Slack is moving off tolerably well, owing to the large consumption for coke making, mill use and chemical and salt works, and notwithstanding heavy stocks sellers seem disposed to hold in anticipation of an improvement in prices as the summer approaches. So far as round coals are concerned, prices of anything are easier, for although there is no quotable alteration on late rates, sellers in many cases are willing to take less. Best coal at the pit mouth can be bought at about 8s. 6d. per ton, seconds at from 6s. 3d. to 7s., and common round coal at from 5s. 3d. to 5s. 9d. per ton; for good slack 3s. to 3s. 3d. per ton is asked, and for common 2s. 3d. to 2s. 6d. per ton. There has been very little doing in the shipping trade and prices for some classes of fuel are now almost as low as ever.

**LEEDS AND WEST YORKSHIRE.**—The iron trade is far more satisfactory all round than it has yet been this year. The common iron industry has been all right for several weeks, and it has kept up so fully to what was hoped would be the case, that they have now advanced the wages of their puddlers, millmen and others to the full extent that is warranted by the recent decision of Mr. Chamberlain, as our fore workmen are, the great majority of them, subject to the same regulations as those enforced in South Staffordshire. But within the last few days the West Yorkshire iron trade has had a most grateful arousing up. The railways—or, at all events, some of them—are at last coming to the rescue of the West Yorkshire ironmasters from the stagnation almost productive of despondency which seemed still to brood over this important department of the iron manufacture while other branches were showing extraordinary vitality and vigour. Some large orders have been given out since our last report for axles, tires, cranks and boiler-plates. What is better still, more are expected too. Taking one Leeds firm that our correspondent has in his mind's eye, sufficient work has already been secured there to keep all hands going at nearly, if not quite, full time for a good many weeks to come. There is not, so far as is known to the outside world, anything remarkable in the terms of these new contracts. Certainly the ironmasters have not made extraordinary good bargains, unless, which is too probably the case, they had accumulated immense stocks of raw material when the depression was at the most extreme point. There is no fresh expansion hereabouts in the matter of steel-making. The future uses of steel are, however, constantly occupying the minds of our several proprietors of large forges. It is evident that the more scientifically disposed among them are constantly giving earnest attention to the subject. We have nothing new to report as to other branches of the iron trade here. The coal trade keeps steady, but at the same time far from brisk.

**LONDON.**—The market for metal remains "shifty," second-hand operators causing considerable fluctuations in prices by bringing speculative parcels to bear upon present values. Nevertheless, for orders to manufacture, makers' prices are maintained. Iron pigs have receded to 65s., but close firmer at 68s. 4½d. Copper maintains a steady tone. 800 tons of ore have been sold by private contract at 15s. per unit. Chili bars, £72 5s. to £72 10s. Tin stronger, £96 having been paid for foreign. English, £101. Lead, rather easier. English pigs £101. Tinplate manufacturers do not show much inclination to yield the prices, though whether second-hand parcels coming into the market will compel them to reduce their prices, remains to be seen. Coke can be bought at 30s.

**NORTH LANCASHIRE AND CUMBERLAND.**—There is no change to note in the industrial position of makers of pig-iron in the district, and it is highly probable that as the season advances there will be increased activity at all the works throughout the district, because makers, having sold their output forward to a considerable extent, are pushing forward the construction of new furnaces, and the remodelling of old furnaces. The demand has not been so pressing during the past few days as of late, but there is, nevertheless, a spirited inquiry, not only on home and American account, but from Continental buyers, who are beginning to find that the expected decline of prices is not likely, at an early date, to be realised. Indeed, with an active demand, and with makers not in a positition to complete delivery on account of new orders for six months, and in some instances for even a longer period than this, there can be no hopes of reducing prices, and particularly so when it is remembered that the spring season is fast approaching. During the past few days transactions have taken place at full prices for forward deliveries, but there is no advance to note in the official quotations published last week. All-round qualities of Bessemer iron realise from 130s. to 135s. per ton at makers' works, and No. 3 forge iron finds a market at 125s. to 130s. per ton at makers' works. Now that there is a very marked consumption of steel the demand on steel makers is not only very considerable, but there is a more than ordinary demand for hematite, as the class of metal from which all qualities of steel is made. The output of the district is greater now than at any previous date, although four or five of the furnaces are out of blast while alterations are being made or preparations taking place in view of their being put in blast so soon as practicable. A very considerable tonnage of steel rails is being produced, and a very active season will be experienced. It is evident that shipbuilders, engineers, ironfounders, and others interested in the industries of the district, are in receipt of new orders, which will enable them to keep at work throughout the year the whole of their machinery. Boiler makers and railway rolling stock makers are doing a brisk trade. Iron ore is in a steady and full demand, but the supply is not equal to the requirements of consumers. Coal is in fair demand at undisturbed prices. Coke is in large request at improved prices.

**NORTH STAFFORDSHIRE.**—The finished-iron trade is in much the same condition as reported last week. The orders on the books keep the works throughout the district in the fullest activity, but the receipt of new orders continues quiet, though it is probable that buyers are merely waiting until makers are more free to enter into new contracts. The ordinary merchant mills are running full time, and some heavy specifications of plates have been lately placed. The demand for hoops is also very brisk, makers being full of orders, but there is a slight falling off in the enquiries for large sections, such as are used in engineering works. The current transactions are chiefly on account of the United States, the latest reports from which indicate a continuance of the flow of orders from that market. The home trade is quieter than at any period since the present improvement commenced. Prices are very firm, with an inclination upwards. A considerable amount of business is being done in pig-iron, the make of which is being increased, and prices are steady. Ironstone still commands a brisk sale, at enhanced rates. The demand for coal is very active, and the output has been recently augmented, but quotations do not make much advance, and, indeed, in some cases, are at a point which is by no means remunerative.

**SHEFFIELD.**—The iron trade, though maintaining its activity, is not showing any indications of a rise, on the contrary, during the past week some qualities have fallen a little in price. Better-class makes, however, command a ready sale. Pig-irons (Derbyshire) are fetching from £3 15s. to £4; No. 3, £3 15s., and hematite, £6 10s. to £6 15s. The forge irons are daily more enquired after and Derbyshire smelters are consequently much more busy. Many of the ironmasters in this district have sold forward for six months to come, and in some localities old orders at the prices of October last are not yet completed. The improvement in the iron trade has, however, given a great impetus to trade in this district, and indications are that the improvement will continue. Reports which come from America show a growing demand for English irons, and though it was said that the Americans are building new mills to turn out increased quantities of railway material, yet agents do not seem for the present to fear any diminution of the demand from that quarter. This is the more noticeable inasmuch as the Press of the States has for some time past stated that the demand for English rails, &c., would shortly be checked. The majority of the rail orders at present in hand in Sheffield are for the States, but a large bulk is also being sent to Northern India. However, companies are ordering tires, axles, and springs more freely, and on this latter class of work mills, which for many months had been idle, are now fully employed. The plate, sheet, and and hoop trade is extraordinarily brisk at the following rates:—Boiler plates (extra), £13 10s.; ordinary, £10 10s.; merchant bars, £9 10s.; hoops, £11 10s. Iron plates for ships were also being consigned to the North of England heavily, £13 being required for the best. In the steel trade there are also heavy requirements. Bessemer steel plates, both for ship and boiler purposes are becoming daily more saleable, and up to £18 is asked for the latter. Some of the largest firms in Sheffield are now working steel boilers, and find them more economical than iron ores. The question of prejudice, however, yet remains, and will not easily be overcome. The armour-plate department is very busy. Since the success has been assured of composite plates—steel and iron fused—heavy contracts have come to hand for the home and several of the Continental Governments. The ordinary steel ship-plate trade is, however, one which the manufacturers of Sheffield are for the present unable to overtake. This makes it certain that hematite irons will keep up in price for some months to come. The supply at present is fairly good, but it is noticeable that buyers are stocking at the rates of the day, and experienced men know what this means. As an instance of the recent extraordinary advance in rates, it may be stated that ingot steel made on Siemens' gas process, offered freely at £7 10s. in October last, is now realising £14 5s. The file trade is the only one in the old staple industries which indicates any marked improvement. Russian orders are, however, pouring in for these goods, and one firm a week ago took a line for 40,000 dozen assorted. Sheep shears are enquired after freely, but the competition is keeping down rates, and consequently profits. In this line it appears to be a question, "Who shall be first?" There is an improvement in the cutlery trades, and business is steadily increasing both in extent and value.

**SOUTH STAFFORDSHIRE.**—In most of the hardware branches there is sustained activity both on home and foreign account. There is more work at the leading japanning factories; buyers are anxious to do business while prices are so favourable. The tin-plate-working firms also report themselves fairly well employed. In the galvanising branch there is quite as much business doing as a week ago, the orders in hand are mainly for foreign buyers. The Australian mail delivered at the close of last week brings the news of important advances in values. When the mail left, ordinary English brands of galvanised sheets could not be bought in Melbourne at under £24, and sales of best brands were reported at £25 to £26. For fencing-wire Nos. 6, 7, and 8, drawn, £12 10s. to £13s. 5s. and £13 15s. was the quotation. In tin-plates sales were recorded at an advance of 15 per cent., and hollow-wares were quoted 35 per cent. off list. Ewbanks' nails had advanced to list price; French nails had risen to £1 1s., but American nails were nominal at 155s. The orders that the Australian mail has brought are larger than of late. At home the tendency to further advance hardwares is checked by the not over-flourishing state of the demand, and the stationary character of iron quotations. The ironworks are fully on, but new orders are not so plentiful. Marked bars are £9.

**WEST CUMBERLAND.**—Makers of pig-iron in this district have their hands so full of business that they have considerable difficulty in meeting their delivery engagements, and on the other hand they are in daily receipt of enquiries with a view to further contracts being entered into. Prices are ruling firm, but there is no definite advance in value. Pig-iron in fact seems to be at a stand, and the upward tendency seems to have recalled a check. This has been brought about by the fact that while, on the one hand, makers are so largely sold that they do not care to entertain any more orders for some months to come, buyers are, on the other hand, disinclined to make large purchases for delivery in six or twelve months at prices current. There are evidences, however, of a brisk enquiry from America this year beyond the very large deliveries which have to be made in this direction; and on Continental account, a demand is springing up which is likely to have an important bearing on the years activity, while on home account the various departments of trade dependent more or less on the iron trade will probably require several very large consignments of crude and manufactured metal. All the furnaces in the district will soon be in full work, as efforts are being made to put those now out of blast in working order as soon as possible. The steel trade is showing signs of considerable growth. The demand is brisk from all directions, and makers are very largely sold forward. New plant is being made to develop this branch of industry. The output at present, of course, is railway material, but makers are extending their trade in other directions. Finished iron works are working full time, and a large number of orders have lately been received for bars and plates. Makers are not able to meet the demand, and they are, as a consequence, extending their powers of production. Iron ore is in greater demand than raisers, the raw material are in a position to cope with. Sales now, in fact, been made for the whole of the year, and it is only in a few instances where purchases can be made for early delivery. Spain and Ireland are supplying several cargoes of hematite ore which is being used for mixing and other purposes. Coal is in fair demand, but prices are not improving. Native coke sells well, but there is also a heavy consumption of Durham qualities.

# CONTINENTAL MINING AND METALLURGY.

THERE are here and there observable signs of anxiety as to the durability of the present revival in the iron trade. That there can be any proximate relapse of it is of course impossible: a strong demand during the winter will certainly be followed by a stronger demand during the spring, and as we have a moderate right to assume that last year's harvests will have been less fruitful than those we now look for, the impetus acquired in the spring will be well enough supported in the autumn to carry us well through 1880. There are not wanting houses, indeed, which at the present moment have their order books already full for the present year, and we are not sure that there are not some deliveries of pig to America booked for the spring of 1881—the furthest point to which we care to stretch our vision. On the other hand, it becomes more clear, as the statistics of 1879 come to light, that the revival was smouldering all through that year, and has had a practical existence already of some twelve or fifteen months, a period which has to be taken into account in any examination of the question of its durability. The amount of iron which went into consumption in 1878 was a respectable one; the make of 1879 will be found to have advanced on that amount very considerably, and the revival may therefore fairly be distinguished into the colourless period, in which there was simply an increase of business at low profits or no profits, and the golden-tinged period now passing in which profits are rising with demands. A damming-up of demand has led to an overflow of demand. How long will it be before business falls back into its ordinary channel?

## FRANCE.

Rates are still well held, the Paris merchants' tariff reprinted by us on the 30th ult. still being quoted. Generally speaking, the rise has not been so precipitate in France as in neighbouring countries, and has not gone so far. Starting from a higher point, French rates have only been carried by now up to a level with those of Belgium and Germany; and, indeed, Belgium herself has found that she can now and then buy in France at a profit. The caution of the French trade, and the difference in character that exists between the present revival and that of 1872-3 are well illustrated by the failure of the attempt to sell the Alfortville Steelworks. They were put up to auction on the 25th ult., at an upset price of £28,000, and not a single bid was made. The advance which, commencing with pig, has made good way with manufactured irons, has not yet been paralleled in the trades which work up iron. The hardware makers of Maubeuge and Alfortville are still complaining that their turn has not come yet. Recent tenders show, however, that there is no weakness in the general market. On the 30th, 2850 tons of double-headed steel rails were put up to tender at Périgueux, at a maximum estimate of 240 fr. per ton. The only tenders received were respectively 17 and 15 per cent. in advance of this estimate. Chatillon-Commentry quoted 276 fr. or £11. Similarly, for 130 tons of fish plates 14 per cent. above the estimate was tendered, making the tender £9 4s. Another sign of the market having turned completely in favour of sellers is the facility with which combinations are formed amongst them. On the 9th inst. the machine nail makers met at Paris to agree on united action; and in so doing they have but followed the example of the members of many other branches of the iron trade.

In Haute-Marne 240 fr. to 250 fr. is got for coke irons, the latter price being the more common. A further rise is expected as the spring opens. All classes of manufactured irons are rising. A couple of furnaces have been put on blast, at Closmortier and Marnaval respectively. A contract for charcoal pig has been recently concluded in the department at £5 8s., delivery being spread over a twelvemonth. The seller lights a fresh furnace next June. In Meurthe and Moselle 240 fr. (£9 12s.) is the present standard rate. A letter from Longwy states that the stock of forge pig there is completely exhausted, and that the fresh make is sent away to consumers almost before it has time to get cold. The same is taking place with foundry pig. The Micheville works are therefore about to build fresh furnaces, and M. Pouyer-Quertier has decided to carry out his old plans at Villerupt. Messrs. De Wendel will, it is said, commence next month the works for their new establishment at Jœuf, near Briey.

The improvement in which the Centre was so slow to participate is at last particularly strong. There are hopes entertained by forgemasters in the regions of the Loire and Rhône of seeing Bessemer rails at £14; on the business horizon there are seen re-appearing some faint coruscations of the faded splendours of 1873. Metallurgical shares have risen considerably, and colliery shares are rising with the increase in the new rates for coal and coke. There are several collieries, however, in the mortifying position of being bound by long-term engagements at last summer's rates, based on a scale of wages which must undergo revision before those engagements expire. There has, in fact, been some talk, already, of a general strike in the Loire coal district.

It is rumoured that there are Algerian mines producing ironstone similar to that of Mokta-el-Hadid, which are sold forward on remunerative terms to American smelters for the next four years.

The tariff discussion inaugurated with so much effect by M. Tirard, has been continued in the French Chamber of Deputies with considerable vivacity, the free-trade party having had the larger measure of oratorical success. The argumentation of M. Pascal Duprat, who showed that Creusot had paid 10 per cent., Fives Lille, 13 per cent., Gisors, 9·45 per cent., has well sustained the impression made by M. Tirard. The general opinion seems to be that the situation will not be much modified from that created by the treaties of 1860. M. de Freycinet is reported to have said, at Saint-Etienne, that as soon as the general tariff is passed the Government will at once take it in hand to conclude treaties of commerce.

The last *Bulletin* published by the Saint-Etienne Société de l'Industrie minérale contains an exhaustive paper on methods of making patent fuel, a good paper on artificial grindstones (rotary files), and a description of the new explosive gelatine.

BELGIUM.—The following details of the metallurgical imports and exports of Belgium for the last three years are taken from the *Moniteur belge* of the 4th inst.

IMPORTS (in metric tons).

| | 1879. | 1878. | 1877. |
|---|---|---|---|
| Steel | 4,506 | 4,981 | 4,915 |
| Pig and scrap | 194,291 | 207,217 | 184,212 |
| Wire | 2,344 | 3,671 | 4,153 |
| Rails (iron) | 891 | 51 | 448 |
| Plates | 182 | 149 | 333 |
| Section irons | 5,260 | 4,538 | 4,571 |
| Anchors, &c. | 191 | 144 | 129 |
| Nails | 393 | 400 | 415 |
| Unclassed goods | 2,816 | 2,888 | 2,559 |
| Castings | 1,367 | 2,032 | 1,458 |
| Ores, borings, &c. | 614,534 | 833,622 | 783,322 |
| Coal | 718,204 | 701,416 | 656,278 |
| Coke | 11,263 | 20,362 | 21,841 |

EXPORTS (in meteric tons).

| | 1879. | 1878. | 1877. |
|---|---|---|---|
| Steel | 46,657 | 26,956 | 18,237 |
| Pig and scrap | 36,465 | 5,412 | 11,816 |
| Wire | 3,393 | 2,898 | 2,036 |
| Rails (iron) | 29,596 | 34,273 | 42,599 |
| Plates | 23,301 | 23,198 | 16,623 |
| Section irons | 154,495 | 132,769 | 113,150 |
| Anchors, &c., | 7 | — | — |
| Nails | 8,308 | 9,096 | 10,296 |
| Unclassed goods | 20,327 | 17,610 | 13,543 |
| Castings | 12,862 | 10,551 | 1,999 |
| Ores | 182,127 | 240,903 | 216,747 |
| Coal | 4,276,924 | 3,889,411 | 3,515,020 |
| Coke | 593,443 | 576,607 | 575,632 |

The respective yearly totals of the imports and exports of iron and steel we defer giving till next week. We may remark that the Belgian Ministry of Finances has no separate category for steel rails, and this important article of export is grouped with bars, sheets and wire. The increase in the exports of scrap in 1879 is accounted for by the United States demand of 28,262 tons, against *nil* in 1878. The rise in the exports, apart from this article, was tolerably progressive throughout the year, and was by no means confined to the last three months of it. The imports of Spanish and Algerian ores have fallen off in a very remarkable manner. They stood at 70,000 tons in 1877, and at 50,000 tons in 1878; but in 1879 at only 18,000 tons, the decline being chiefly in Spanish ores. The countries which took the heaviest weights of rails were Italy with 18,000 tons steel, and 12,000 tons iron; and Brazil with 9000 tons steel and 6000 tons iron. China took 20,000 tons of merchant iron against 7279 tons in 1878, and some 5000 tons in 1877, thus quadrupling her imports of two years ago. For profile irons England remains Belgium's best customer; but as our figures will refer to the entire years cited, we will give in full an account of the trade between the two countries, the weights being, as before, in metric tons.

IMPORTED FROM ENGLAND.

| | 1879. | 1878. | 1877. |
|---|---|---|---|
| Bar steel | 700 | 762 | 712 |
| Wrought steel | 83 | 249 | 103 |
| Pig and scrap | 66,606 | 69,148 | 75,379 |
| Wire | 228 | 191 | 212 |
| Plates | 6 | 27 | 52 |
| Profile iron | 874 | 554 | 838 |
| Anchors | 156 | 46 | 44 |
| Unclassed irons | 480 | 358 | 442 |
| Castings | 159 | 88 | 191 |

Hereto we may add the following goods, received (probably from England) by way of Holland:—

| | | | |
|---|---|---|---|
| Bar steel | 193 | 9 | 10 |
| Pig and scrap | 22,115 | 29,499 | 13,422 |
| Rail iron | 178 | 11 | 427 |
| Anchors | 4 | 65 | 46 |
| Castings | 30 | 26 | 37 |

There was received from England (direct) the following tonnage of machinery:— 2528 2203 3081

EXPORTED TO ENGLAND.

| | | | |
|---|---|---|---|
| Cast steel | 9 | 55 | 15 |
| Bar steel | 568 | 761 | 193 |
| Wrought steel | 104 | 364 | 164 |
| Pig iron and scrap | 66 | 444 | 915 |
| Wire | 196 | 406 | 210 |
| Rails (iron) | 672 | 247 | 2394 |
| Plates | 217 | 919 | 1992 |
| Section iron | 47,282 | 52,189 | 39,959 |
| Nails | 3649 | 4408 | 4929 |
| Unclassed irons | 1980 | 1921 | 1410 |
| Castings | 322 | 93 | 31 |

We quote as before the exports from Belgium to Holland as being merely received in transit for England, or on English account for re-exportation:—

| | | | |
|---|---|---|---|
| Bar steel | 1,775 | 938 | 253 |
| Wrought steel | 29 | 96 | 429 |
| Pig and scrap | 536 | 86 | 1,025 |
| Wire | 2,079 | 1,227 | 1,069 |
| Rails (iron) | 3,429 | 9,944 | 13,324 |
| Plates | 6,738 | 6,794 | 6,073 |
| Profile irons | 20,401 | 24,960 | 21,636 |
| Nails | 1,074 | 1,205 | 1,496 |
| Unclassed irons | 2,595 | 3,156 | 3,179 |
| Castings | 1,966 | 1,850 | 595 |

The Belgian market appears to have begun to stop to think. Rates are high, and there are not wanting efforts to advance them still further, but there is a general slackening all along the line. In the district of Liége coke has been selling at 30 fr. (£1 4s.) per ton, according to the *Journal de Liége*, but a Longwy iron company has been able to conclude a contract in Germany at 18 fr. (14s. 4d.), and buyers are perhaps beginning to recover from their first astonishment at the extraordinary turn of markets against them, and to avail themselves of their natural recourse to competition. Forge pig is still in strong demand; the Luxembourg syndicate of associated masters has none to sell, and Grand Duchy pig brings £4 4s. in Liége. In the Seraing district there will be a couple more furnaces set on blast before the month is out. Forgemasters in the district have been sending out lists, the prices of which are criticised as factitious compared with those now ruling at Charleroi. The standard price varies between £8 and £9 10s. Plates for constructional purposes are still eagerly inquired for, and a heavy trade is doing in rails. A Charleroi firm is said to have received offers of orders for 20,000 tons of iron rails. The State has put an end to the long history of its thrice-withdrawn adjudication of rails, by sharing out 10,000 tons of iron rails amongst three Belgian firms—namely, Acoz, 7000 tons, Monceau-sur-Sambre 1900 tons, and Boucquéau (La Louvière), 1100 tons—all on the same terms of payment. These are, for each ton of new rails one ton of old (estimated to be worth £6), plus £2 8s. in cash—in all, £8 8s. This is a respectable price, but the three firms above-named have to use the same wariness concerning it that is recommended in the negotiation of Glenfield starch. The same day that the State announced its acceptance of the terms just quoted, the Angleur Steelworks (makers of basic Bessemer steel) contracted with the Northern of Spain for 13,000 tons of steel rails at prices but little in advance of those terms. That is to say, Angleur agrees to deliver at Santander 3000 tons of steel rails in 1880 at £9 10s.; 5000 tons in 1881 at £9; and 5000 tons in 1882 at the same price. This is one among other indications that, amid the fluctuations of the present revival, the end is not too far off to be in view. At present rates of freight the Angleur prices amount only to £8 8s. at the works, and these are not the rates of 1873. It is fair to add that Terrenoire and Creusot asked £10 10s. and £11 respectively, at the works, for the same rails. It is reported that a lot of 5000 rails was recently put up to tender at Brussels by a private firm, and that no tender was received. We have seen, however, no confirmation of this report.

The engineering works are still complaining of want of business. The Meuse Engineering Works, near Liége, are making two blast-engines—one for Longwy, the other for Athus. For Paris points and for forged nails the inquiry continues good at Charleroi.

Industrial shares are either at a standstill at late advance, or have begun to retrograde.

At last Sunday's meeting of the Liége Engineers' Association, M. Greiner gave an analysis of a paper recently published by Chernoff, of St. Peterburg, on the structure of steel. A course of head-over-heels manufacture, like that which has set in, often throws theory into the background, dulls the eye of science, and, finally, dims the fineness of manufacture. It is quite characteristic of the present situation that invention and improvement are little heard of.

A Mr. Florenzano, an Italian gentleman living at Liége, has perfected a process for gilding metals by the simple application of a composition, burnishing afterwards. The effects are said to be equal to those obtained with the battery.

An explanation is offered by the *Semaine industrielle* of its complaint, referred to by ourselves a fortnight ago, of engineering work in Belgium being given to an English house. Not because of the nationality of the house, but because of the non-observance of the principle of open competition was the transaction criticised. We wish to give ample acknowledgment to the consistency and gallantry of *La Semaine* in supporting sound principles of trade, but there still remains to be accounted for the bitterness with which the deflection of Belgian business to *an English house* (!) was so promptly noticed.

GERMANY.—From no country are reports so cheerful or so hopeful as from Germany. Prices are rising still, both for pig and manufactured goods. From this continuance of demand an argument is drawn for the continuance of the revival; it is quite certain, however, that the wave must fall after it has risen to its highest; and the quick-changing conditions of modern trade are so far recognised, that no one ventures to speculate on a "steady run" of business for five or ten years forward. However, there is little doubt of trade being steady in Germany throughout the present year. The blast-furnaces in the German Black Country—Rhenish Westphalia—are unable to keep German mills supplied with pig, and imports of English pig are taking place. In

Loraine, Luxemburg, and Siegen, fresh furnaces are being erected, but they will hardly be able to make their presence felt before the turn of the half year, when the demand will probably have reached its maximum. The mills are crowded with work, and are unable to accept any short-term business. There is a strong inquiry for boiler plates, showing that there is a generally larger demand for power, and that the period of putting off repairs and completions is coming to a close. Engineering and constructional works are, as a matter of course, growing very busy. The following are a few maximum quotations for Feb. 2, at Dortmund :—

| | £ | s. |
|---|---|---|
| German foundry pig .. | 5 | 5 |
| ,, Bessemer pig .. | 6 | 0 |
| Common bars .. .. | 10 | 15 |
| Angles .. .. | 11 | 5 |
| Beams .. .. .. | 10 | 10 |
| Boiler plates .. .. | 13 | 10 |
| Bessemer rails .. .. | 12 | 10 |

These prices do not include carriage.

NOTE.—To the list of German converters we gave last week add that belonging to the Maxhütte at Welmborn, a couple of miles from Saalfeld.

AUSTRIA.—This far-off member of the iron trade is beginning to feel the freshening influence of the new life which has come upon the trade in general. The forgemasters' association still holds together, and quotations are now made on the paying footing of 60 fl. for white pig and 150 fl. for bars. In Bohemia, Moravia, and Hungary, prices are getting firmer. Some heavy orders in railway material for permanent way on home account are anticipated, and Austrian works have had a great success in the late international competition for 10,000 tons of steel rails for the Alta Italia Railway. There were twenty-seven houses invited to compete seven only tendered, only one of these being an English (Cumberland) firm. Its tender was £13 5s. delivered at Genoa. Four Westphalian steelworks tendered at rates varying from £11 2s. 6d. to £12 5s., also delivered at Genoa. There was no French or Belgian tender. The rails accordingly fell to those Austrian works lowest in their offers—the Styrian Ironworks (£10 delivered at Pontebba), the Hüttenbgerer Ironworks (£10 8s. delivered at the Italian frontier), and the Graz Ironworks, belonging to the Südbahn (same terms). This singular Austrian success is attributed on the one hand to the absence of English competition, and on the other to improvements in the methods of manufacture in Austria, and the facilities of carriage offered by the Pontebba Railway. In May of last year Cockerill won against eighteen competitors for similar business with £5 2s. 6d.

The Austrian nailmakers have syndicated themselves, and from February 1st nails will carry the advances which has taken place in irons and sheets. A similar movement for joint action against buyers has taken place amongst the locksmiths and hardware makers. The rise in manufactured goods would be about 15 per cent. on January lists.

The Hungarian State Railway has sold 2000 tons of old rails to America at 60 fl. delivered at France. M. Boutour, formerly manager to the Südbahn, is reported to have contracted for 60,000 tons of rails with various French firms for Bahia for 1880, with the option of 60,000 tons more in 1881. The North-Eastern of Hungary will let tenders on the 18th inst. for 1800 tons of steel rails and the requisite accessories.

RUSSIA.—The efforts of the Government to encourage native manufacture have not been entirely successful, railmakers being hampered by the restrictions laid upon them in the purchase of pig from abroad. A conference of the iron and steel trades is to be held in the course of the present month at the offices of the Department for Railways, at which the representatives of those trades will be invited to lay their difficulties, and suggestions for their removal, before the Department.

## NEW PATENTS.

ALL the Patents are placed Alphabetically, with the official numbers attached. The New Applications range from No. 463 to No. 568, being the entries from Feb. 4th, to Feb. 9th.

### NEW APPLICATIONS.

**Advertising.**—*J. Frearson, Birmingham.* [534
**Alarm Apparatus.**—*F. A. Guy, London.* [517
**Alarm Apparatus.**—*F. W. Tuckhurst and J. Cheshire, Birmingham.* [518
**Blast Furnaces.**—A communication.—*C. D. Abel, London.* [557
**Bedsteads.**—A communication.—*W. Morgan-Brown, London.* [472
**Bicycles.**—A communication.—*J. Imray, London.* [492
**Bicycles.**—*P. W. Jones, Exeter.* [504
**Bolt-Heading Machinery.**—A communication.—*H. H. Lake, London.* [467
**Braid Machines.**—*G. F. James, Salford.* [527
**Butter Print Blower.**—*C. Harryman, Ross, Herefordshire.* [508
**Carding Engines.**—*G. Ashworth and B. Ashworth, Manchester.* [542
**Carriage Springs.**—A communication.—*W. R. Lake, London.* [534
**Carriage Springs.**—A communication.—*W. R. Lake, London.* [532
**Carriage Springs.**—A communication.—*W. R. Lake, London.* [547
**Carriage Steps and Lamp Sockets.**—*G. B. Northcote, Handsworth, Staffordshire.* [559
**Carriage Windows.**—*H. G. Cox, Chorlton-on-Medlock, Lancashire.* [464
**Cigar Cabinet-Table.**—*G. H. Tipper, London.* [546
**Coal, &c., Boxes.**—A communication.—*W. R. Lake, London.* [552
**Coal Gas Purifier.**—*C. C. Walker, Lilleshall, Shropshire, and W. T. Walker, London.* [545
**Colouring Matters.**—A communication.—*J. A. Dixon, Glasgow.* [536
**Composing Machine.**—*A. Hilpiker, London.* [510
**Corset Attachments.**—*R. Goff, Forest Gate, Essex.* [563
**Coupling Arrangements.**—*G. F. Hopkins, Kenilworth.* [494
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## COMMERCIAL.

### LONDON PRICE LIST OF METALS, ORES, OILS, CHEMICALS, &c.

[FOR THE PRESENT AND PAST WEEK.]

(Metal Market, City, Thursday Afternoon, 4 P.M., (*February* 12, 1880.)

### METALS AND ORES.

| | February 5. | | February 12. | |
|---|---|---|---|---|
| | £ s. | £ s. | £ s. | £ s. |
| COPPER (per ton)— | | | | |
| Chili, for 90 per cent. | 72 10/ | — | 72 10/ | — |
| Wallaroo | 81 0/ | — | 81 0/ | 84 0/ |
| Burra Burra | 80 0/ | — | 80 0/ | 81 0/ |
| English Tough | 79 0/ | 80 0/ | 78 0/ | 79 0/ |
| English Ingot best | 80 10/ | 81 0/ | 80 10/ | 81 0/ |
| Sheets sheathing and rod | 84 0/ | 85 0/ | 82 0/ | 83 0/ |
| Bottoms | 88 0/ | 100 0/ | 88 0/ | 100 0/ |
| Ore per unit | 0 13/9 | 0 14/ | 0 14/6 | 0 15/ |
| PHOSPHOR BRONZE | | | | |
| Special Bearing Metal (p tn) | 119 0/ | — | 119 0/ | — |
| Other alloys (per ton | 126 0/ | 142 0/ | 126 0/ | 142 0/ |
| TIN (per ton)— | | | | |
| Straits (Cash) | 97 0/ | — | 96 0/ | — |
| Do. for arr. | — | — | — | — |
| Billiton | — | — | — | — |
| Banca | — | — | — | — |
| English Ingots | 103 0/ | — | 101 0/ | — |
| Do. Bars | 104 0/ | — | 102 0/ | — |
| Do. Refined | 106 0/ | — | 104 0/ | — |
| Australian | 97 0/ | — | 96 0/ | — |
| TIN PLATES, per box, I.C. coke f.o.b. London | 0 30/ | 0 32/ | 0 30 6 | 0 31/ |
| IX. do. | 0 35/ | 0 40/ | 0 37/6 | 0 38 6 |
| I.C. charcoal | 0 34/ | 0 36/ | 0 35/ | 0 38/ |
| I.X ,, | 0 40/ | 0 44/ | 0 40/ | 0 42/ |
| LEAD (per ton)— | | | | |
| Soft English pig | 19 0/ | 19 10/ | 19 0/ | 19 5/ |
| Do. W.B. | — | — | — | — |
| Spanish soft | 18 17/ | 18 15/ | 18 10/ | 18 15/ |
| Do. with silver | — | — | — | — |
| Sheet milled | 19 10/ | 19 15/ | 20 0/ | 21 0/ |
| Red lead | 20 10/ | — | 20 10/ | — |
| White | 24 0/ | — | 24 0/ | — |
| Patent shot | 22 0/ | 23 0/ | 22 0/ | 23 0/ |
| ZINC (per ton)—from No. 9 Gauge. | | | | |
| Sheets, rolled | 25 0/ | — | 25 0/ | — |
| Do., foreign | 25 5/ | — | 25 10/ | — |
| SPELTER (per ton)— | | | | |
| Silesian, com | 21 0/ | — | 21 5/ | — |
| Rhenish | — | — | — | — |
| English | — | — | — | — |
| QUICKSILVER, bot. | 7 5/ | 7 10/ | 7 0/ | 7 5/ |
| ANTIMONY ore (per ton)— | | | | |
| Australian | 11 10/ | 14 10/ | 11 10/ | 14 10/ |
| Spanish | — | — | — | — |
| French Star | 71 0/ | — | 71 0/ | — |
| Regulus— | | | | |
| Crude (per cwt.) | 1 14/ | — | 1 14/ | — |
| NICKEL (per lb.) | 0 3/ | — | 0 3/ | — |
| BRASS (per lb.)— | | | | |
| Sheets, 48 × 24. | 0 0/8 | — | 0 0/8 | — |
| Tubes | 0 0/11 | 0 1/ | 0 0/11 | 0 1/ |
| Wire | 0 0/8½ | — | 0 0/8½ | — |
| Yellow metal | — | — | — | — |
| ASBESTOS (per lb.) | 0 0/3 | 0 1/ | 0 0/3 | 0 1/ |
| PLUMBAGO (per ton)— | | | | |
| Ceylon lump | 0 17/6 | — | 0 17/6 | — |
| Do. chip | 0 10/6 | — | 0 10/6 | — |
| Do. dust | 8 6/ | — | 8 6/ | — |
| COALS (per ton)— | | | | |
| East Hartlepool | 1 2/ | — | 1 2/ | — |
| Lambton | 1 4/ | — | 1 4/ | — |
| Tees | 1 4/ | — | 1 4/ | — |
| Hartley | 1 2/ | — | 1 2/ | — |
| Hetton | 1 4/ | — | 1 4/ | — |
| Hawthorn | 1 3/ | — | 1 3/ | — |
| Tunstall | 1 2/ | — | 1 2/ | — |

### IRON.

| | February 5. | | February 12. | |
|---|---|---|---|---|
| IRON, per ton (at works)*— | £ s. | £ s. | £ s. | £ s. |
| Bars, Welsh, common | 6 5/ | 6 7/ | 6 5/ | 6 7/ |
| Do. Best | 7 0/ | — | 7 0/ | — |
| Scotch, Common | 8 10/ | — | 8 10/ | — |
| Do. Best | 9 0/ | — | 9 0/ | — |
| South Stafford, common | 8 0/ | — | 8 0/ | — |
| Do. Best | 8 10/ | — | 8 10/ | — |
| Sheets, singles, Cleveland | 9 0/ | — | 9 0/ | — |
| Staffordshire | 9 5/ | 9 10/ | 9 5/ | 9 10/ |
| Do. doubles, Staffordshire | 10 15/ | 11 5/ | 10 15/ | 11 5/ |
| Scotch | 10 5/ | — | 10 5/ | — |
| Do. Lattens, Staffordshire | 12 5/ | 12 15/ | 12 5/ | 12 15/ |
| Plates, Ship, Stafford. | 10 0/ | 10 5/ | 10 0/ | 10 5/ |
| Do. Scotch | 8 5/ | 8 15/ | 8 5/ | 8 15/ |
| Do. do. Stafford. | 12 0/ | 12 10/ | 12 0/ | 12 10/ |
| Do. Boiler, Stafford. | 9 0/ | 10 0/ | 9 0/ | 10 0/ |
| Hoops, Stafford | 8 10/ | 9 0/ | 8 10/ | 9 0/ |
| Nail Rods, Stafford | 7 17/6 | 9 0/ | 7 17/6 | 9 0/ |
| Swedish in Lond. | 11 0/ | 11 10/ | 11 0/ | 11 10/ |
| Angle Iron, Welsh | 7 10/ | 9 0/ | 7 10/ | 9 0/ |
| Do. Stafford | 8 10/ | 9 10/ | 8 10/ | 9 10/ |
| Pud. Bars, Welsh | — | — | — | — |
| Do. Stafford | 6 0/ | 6 10/ | 6 0/ | 6 10/ |
| Do. Scotch | — | — | — | — |
| Rails, Welsh | 8 0/ | 8 10/ | 8 0/ | 8 10/ |
| Do. Stafford | 8 10/ | 9 10/ | 8 10/ | 9 10/ |
| North England | 5 5/ | — | 5 5/ | — |
| Light Rails, Welsh | 8 5/ | 8 15/ | 8 5/ | 8 15/ |
| Do. Stafford | 8 15/ | 9 15/ | 8 15/ | 9 15/ |
| Pig Iron at Glasgow | | | | |
| Scotch warrants.. | 3 5/ | — | 3 8 6½ | — |
| Do. No. 1 | 3 10/ | 4 0/ | 3 12 6 | 4 0/ |
| Cleveland, Tyne or Tees | 3 0/ | — | 3 0/ | — |
| Indian Charcoal, London | — | — | — | — |
| Wrought Iron Girders | 13 0/ | 18 0/ | 13 0/ | 18 0/ |
| Bolts and Nuts | 13 0/ | 15 0/ | 13 0/ | 15 0/ |
| Fish Bolts | 13 0/ | 20 0/ | 13 0/ | 20 0/ |
| Washers | 13 10/ | 14 0/ | 13 10/ | 14 0/ |
| Rivets | 10 0/ | 13 0/ | 10 0/ | 13 0/ |
| Spikes | 12 10/ | 14 10/ | 12 10/ | 14 10/ |
| SWEDISH IRON— | | | | |
| f.o.b. Gottenburg, nett cash. | | | | |
| Pig | — | — | — | — |
| Bar, rolled | 11 0/ | 11 10/ | 11 0/ | 11 10/ |
| Do. hammered | 11 0/ | 11 10/ | 11 0/ | 11 10/ |
| Billets | 13 10/ | — | 13 10/ | — |
| Horse Nail Rods | 14 0/ | 14 10/ | 14 0/ | 14 10/ |
| BELGIAN IRON— | | | | |
| f.o.b. Antwerp, less 2½ per cent. | | | | |
| Bars and Slit Rods, common | Nominal. | | | |
| Best | | | | |
| Best Best | | | | |
| Hammered | | | | |
| Puddled Steel | | | | |
| Bessemer | | | | |
| Hoops | | | | |
| Rails | | | | |
| Rolled Girders | | | | |
| STEEL— | | | | |
| Best cast | 40 0/ | 42 0/ | 40 0/ | 42 0/ |
| Do. dbl. shear | 45 0/ | — | 45 0/ | — |
| Do. single do. | 38 0/ | 40 0/ | 38 0/ | 40 0/ |
| English spring med. quality | 12 0/ | 22 0/ | 12 0/ | 22 0/ |
| Blister | 21 0/ | 34 0/ | 21 0/ | 34 0/ |
| Swedish keg | 16 0/ | — | 16 0/ | — |
| Milan | 25 0/ | 28 0/ | 25 0/ | 28 0/ |
| Bessemer rails | 6 5/ | — | 6 5/ | — |
| Do. tires | 11 0/ | 15 0/ | 11 0/ | 15 0/ |
| Do. billets | 7 10/ | 10 0/ | 7 10/ | 10 0/ |
| Do. ingots | 7 0/ | 8 0/ | 7 0/ | 8 0/ |
| SCRAP (per ton)— | | | | |
| Old rails for remanufacture, D.H. | 4 0/ | — | 4 0/ | — |
| Ditto flange or bridge | 4 10/ | 6 0/ | 4 10/ | 6 0/ |
| Engineers' scrap | 3 0/ | 4 0/ | 3 0/ | 4 0/ |
| Light scrap | 3 0/ | — | 3 0/ | — |
| Scrap metal | 2 0/ | 3 0/ | 2 0/ | 3 0/ |
| Old steel scrap | 3 15/ | 4 10/ | 3 15/ | 4 10/ |
| WIRE— | | | | |
| Best best drawn killed gal. tel., Nos. 0 to 6 | 17 0/ | — | 17 0/ | — |
| Do. 7 & 8 | 18 0/ | — | 18 0/ | — |
| Do. 9 | 18 15/ | — | 18 15/ | — |
| Do. 10 | 19 10/ | — | 19 10/ | — |
| Do. 11 | 20 0/ | — | 20 0/ | — |
| Do. 12 | 21 0/ | — | 21 0/ | — |
| Rolled black fencing wire (per ton) 1 to 4 | 10 10/ | — | 10 10/ | — |
| Do. 5 | 11 0/ | — | 11 0/ | — |
| Do. 6 | 11 10/ | — | 11 10/ | — |
| Do. 7 | 12 0/ | — | 12 0/ | — |
| Bright Iron Wire (Charcoal wire, 4s. 6d. per bundle extra) per bundle of 63 lb. 0 to 6 | 0 13/ | — | 0 13/ | — |
| Do. 7 to 8 | 0 13/6 | 0 13/9 | 0 13/6 | 0 13 9 |
| Galvanised, 80s. per ton extra. | | | | |
| Best best annealed drawn fencing wire, per ton 0 to 6 | 12 5/ | — | 12 5/ | — |
| Do. 7 | 12 15/ | — | 12 15/ | — |
| Do. 8 | 13 0/ | — | 13 0/ | — |
| CASTINGS (per ton) at works— | | | | |
| Girders | 6 10/ | 7 10/ | 6 10/ | 7 10/ |
| Chairs | 4 10/ | 5 0/ | 4 10/ | 5 0/ |
| Floor plates | 5 12/6 | — | 5 12/6 | — |
| Pipes, 1½ to 2in. | 6 12/6 | 7 0/ | 6 12/6 | 7 0/ |
| Do. 3 ,, 4 | 6 2/6 | 6 5/ | 6 2/6 | 5 5/ |
| Do. 5 ,, 8 | 6 1/6 | 6 4/ | 6 1/6 | 6 4/ |
| Do. 10 ,, 16 | 6 0/ | 6 2/6 | 6 0/ | 6 2/6 |
| Do. 18 ,, 24 | 5 17/6 | 6 0/ | 5 17/6 | 6 0/ |
| Bolts and Nuts | 17 10/ | 20 0/ | 17 10/ | 20 0/ |
| Fish Bolts | 18 10/ | 21 0/ | 18 10/ | 21 0/ |
| Spikes | 17 10/ | 18 10/ | 17 10/ | 18 10/ |
| Rivets | 14 10/ | 21 0/ | 14 10/ | 21 0/ |
| Washers | 19 10/ | 21 10/ | 19 10/ | 21 10/ |

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* The entire ton consists of ten times 100 kilogrammes, or about 30 lb short of an English ton.

## OILS, CHEMICALS, &c.

| | February 5. £ s. | £ s. | February 12. £ s. | £ s. |
|---|---|---|---|---|
| **Oils (per tun)—** | | | | |
| Olive, Malaga | — | — | — | — |
| Do. Gioja | — | — | — | — |
| Do. Levant | 42 0/ | 43 0/ | 42 0/ | 43 0/ |
| Do. Mogador | — | — | — | — |
| Do. Tunis | — | — | — | — |
| Do. Seville | 45 0/ | — | 45 0/ | — |
| Do. Sicily | 45 0/ | 46 0/ | 45 0/ | 46 0/ |
| Seal, pale | 30 0/ | — | 30 0/ | 30 10 |
| Seal, yellow | 27 0/ | — | 27 0/ | — |
| Seal, brown | 25 0/ | — | 25 0/ | — |
| Sperm head | 70 0/ | 71 0/ | 70 0/ | 71 0/ |
| Cod | 27 0/ | — | 27 0/ | 27 10 |
| Whale, pale | 26 10/ | — | 26 10/ | — |
| Do. yellow | 25 10/ | — | 25 10/ | — |
| Do. brown | 20 0/ | — | 20 0/ | — |
| E.I. Fish | — | — | — | — |
| Rapeseed, English, pale | 31 5/ | — | 31 5/ | — |
| Do. brown | 29 5/ | — | 28 15/ | 29 0/ |
| *Foreign Pale | — | — | — | — |
| Ground nut and Gingelly Madr. | — | — | 31 0/ | — |
| Palm oil, fine | 35 15/ | — | 35 15/ | — |
| Palm nut oil | 35 10/ | — | 35 10/ | — |
| Linseed oil | 27 0/ | — | 27 2/6 | — |
| Cotton seed oil | 28 10/ | 29 5/ | 28 10/ | 29 5/ |
| Lard | 44 0/ | — | 43 10/ | 46 0/ |
| Cocoanut, Cochin | 38 0/ | — | 38 0/ | 39 0/ |
| Do. Ceylon | 35 10/ | — | 34 10/ | — |
| Mauritius | 37 10/ | — | 37 10/ | — |
| C. Price & Co.'s patent engine oil (per gal.) | 0 3/6 | — | 0 3/6 | — |
| **Oil Cake (per ton)—** | | | | |
| Linseed, Ldn. | 11 5/ | 11 10/ | 11 5/ | 11 10/ |
| American bls. | 10 10/ | — | 10 10/ | — |
| Do. bags | 10 12 6 | — | 10 12/6 | — |
| Marseilles | 9 15/ | — | 9 15/ | — |
| Rape, English | 5 0/ | — | 5 0/ | — |
| Do. Foreign | — | — | — | — |
| Green Cotton | 6 0/ | 7 10/ | 6 0/ | 7 10/ |
| Tallow—PYC. | 43 0/ | — | 45 0/ | — |
| S. Americn. Beef | 41 0/ | — | 41 0/ | — |
| Do. Sheep | — | — | 38 6/ | — |
| Australian Beef | 36 0/ | — | 36 0/ | — |
| Do. Sheep | 40 10/ | — | 36 6/ | 39 0/ |
| Rough Town Fat | 14 0/ | — | 14 0/ | — |
| **Petroleum—** | | | | |
| Fine (per gal.) | 0 0/5½ | 0 0/6 | 0 0/5 15-16 | 0 0/6¼ |
| Do. spirit | 0 0/7 | 0 0/7½ | 0 0/7¼ | 0 0/7½ |
| **Turpentine—Spirit—** | | | | |
| French | — | — | — | — |
| American (casks) | 1 12/3 | — | 1 12/3 | — |
| **Whalefins (per ton)—** | | | | |
| Davis' Straits | 1100 0/ | — | 1100 0/ | — |
| Arctic | 1000 0/ | 1000 0/ | 1000 0/ | 1000 0/ |
| Southern | 500 0/ | — | 500 0/ | — |
| **Brimstone (per ton)—** | | | | |
| Rough, 2ds Ind. | 7 0/ | — | 7 0/ | — |
| Do. 3rds, do | 5 10/ | — | 5 10/ | — |
| Roll | 8 15/ | — | 8 15/ | 9 15 |
| **Sulphur, Flour** | 10 15/ | 12 0/ | 10 15/ | 12 0/ |
| **Acid, (per lb.)** | | | | |
| Acetic, fine | 0 0/4 | — | 0 0/3 | 0/3 3-14 |
| Do. common | 0 0/2½ | 0 0/3 | 0 0/2½ | 0 0/2¼ |
| Citric | 0 2/1 | 0 2/4 | 0 2/5 | — |
| Muriatic fine (per cwt.) | 0 4/ | 0 7/ | 0 4/ | 0 7/ |
| Do. common | 0 4/ | 0 5/ | 0 4/ | 0 5/ |
| Nitric | 0 0/4 | — | 0 0/4½ | — |
| Oxalic (per lb.) | 0 0/5½ | 0 5½ | 0 0/5 | 0 5½ |
| Sulphuric, concentrated | 0 0/0¾ | 0 0/1 | 0 0/0¾ | 0 0/1 |
| Do. Brown | 0 0/0¾ | 0 0/1 | 0 0/0¾ | 0 0/1 |
| Tartaric Crystal | — | 0 1/7 | 0 1/7 | — |
| Do. Pulv. | 0 1/5½ | 0 1/7 | 0 1/5½ | — |
| **Ammonia—** | | | | |
| Carbonate, per lb. | 0 0/6½ | 0 0/6¾ | 0 0/6½ | 0 0/6¾ |
| Sulphate, White & grey (per ton) | 20 0/ | — | 20 0/ | — |
| **Arsenic**—White Lump (per ton) | 23 10/ | 24 0/ | 23 10/ | 24 0/ |
| Powdered, do. | 11 0/ | 11 3/ | 11 3/ | 11 6/ |
| Bleaching powder | 0 8/9 | — | 0 9/ | — |
| **Borax**, Rfd., do. | 1 19/ | — | 2 10/ | — |
| **Copperas** (ton) | 2 10/ | 3 5/ | 2 10/ | 3 5/ |
| **Bi-Sulphide Carbon** (per ton) | 24 10/ | 26 0/ | 24 10/ | 26 0/ |
| **Portland Cement—** | | | | |
| 1st quality, in cks 400 lb. gross, inc. csks., f.o.b., Thames, per csk | 0 9/ | — | 0 9/ | — |
| Do. in sks, 200 lb. net (per ton) | 2 0/ | — | 2 0/ | — |
| Sacks extra, 1/0 each. | | | | |
| Charlton White Paint (per cwt.) | 1 12/ | — | 1 12/ | — |
| Calley's Torbay Paint, Brown | 0 30/ | — | 0 30/ | — |
| Do. Red | 0 34/ | — | 0 34/ | — |
| **Hypophosphites (per lb.)—** | | | | |
| Iron | 0 9/3 | 0 10/ | 0 9/3 | 0 10/ |
| Lime | 0 5/3 | 0 7/ | 0 5/3 | 0 7/ |
| Magnesia | 0 9/ | 0 9/ | 0 9/ | 0 9/ |
| Manganese | 0 9/ | 0 9/ | 0 9/ | 0 9/ |
| Soda | 0 5/3 | 0 6/ | 0 5/3 | 0 6/ |
| **Lead (per cwt.)—** | | | | |
| Acetate, best | 2 0/ | — | 2 0/ | — |
| Nitrate | 1 15/ | — | 1 15/ | — |
| Red | 1 3/ | — | 1 3/ | — |
| White | 1 4/ | — | 1 4/ | — |
| **Litharge** (pr cwt.) | 1 1/ | 1 2/ | 1 1/ | 1 2/ |
| **Lime (per ton)—** | | | | |
| Acetate, Grey, 85% | 0 19/ | — | 0 19/ | — |
| Do. Brown 70% | 11 0/ | — | 11 0/ | — |
| **Potash—** | | | | |
| Bichromate (lb.) | 0 0/7 | — | 0 0/7 | — |
| Chlorate (pr. lb.) | 0 0/7¾ | — | 0 0/7¾ | — |
| Muriate, 80% ton | 6 15/ | — | 6 15/ | — |
| Pruss. Red (lb.) | 0 1/11 | — | 0 1/11 | — |
| Do. Yel. lb. | 0 0/11¼ | 0 1/ | 0 0/11¼ | — |
| Sulphate, 80% (per ton) | 14 0/ | 16 0/ | 14 0/ | — |
| **Saltpetre (per cwt.)—** | | | | |
| Engl. refnd. kgs. | 1 7/6 | — | 1 7/6 | — |
| Do. barrels | 1 6/ | — | 1 6/ | — |
| Do. Bengal | 0 19/6 | 1 1/6 | 0 19/6 | 1 1/6 |
| **Soda—** | | | | |
| Ash ... deg. | 0 0/1 15-16 | 0 2/ | 0 0/1 15-16 | 0 2/ |
| Bicarb. (per cwt.) | 0 11/9 | 0 12/ | 0 12/6 | — |
| Caustic, 60% | 0 12/6 | 0 13/6 | 0 12/6 | 0 13/ |
| Do. 72% | 0 13/ | — | 0 13/ | — |
| Nitrate | 0 19/ | — | 0 19/ | — |
| Crystals (per ton) | 4 5/ | 4 7/6 | 4 5/ | 4 7/6 |

* Per ton extra in London, Staffordshire, 15s.; Scotch, 10s.; Lancashire, 15s.; Welsh, 10s.

KITCHENS MADE LIGHT by means of Chappuis' Daylight Reflectors; the cost is from 25s.; the saving in gas or oil soon makes up for that outlay. Prospectuses sent on receipt of two stamps, addressed (I.) Chappuis, Patentee, 69, Fleet Street, London.—[ADVT.]

## THE BOARD OF TRADE RETURNS

OF the exports of iron, steel, and other metals, with coal, coke, and patent fuel, from the United Kingdom during the month of January, 1878, as compared with that of 1879. Also the exports for the month of January 1880.

| Articles, and to what Countries Exported. | Jan., 1878. | Jan., 1879. | Jan., 1880. |
|---|---|---|---|
| **IRON—Pig.** | Tons. | Tons. | Tons. |
| To Russia | — | 40 | 76 |
| Germany | 4,207 | 5,781 | 4,145 |
| Holland | 8,272 | 12,025 | 10,380 |
| Belgium | 7,419 | 6,383 | 16,311 |
| France | 10,768 | 8,680 | 7,031 |
| United States | 1,627 | 3,261 | 56,570 |
| British N. America | 627 | 30 | 200 |
| Other countries | 10,023 | 11,331 | 6,973 |
| Total | 42,943 | 47,534 | 102,565 |
| **Bar, Angle, Bolt and Rod.** | | | |
| To Russia | 310 | 28 | 473 |
| Germany | 291 | 206 | 459 |
| Holland | 123 | 188 | 114 |
| France | 22 | 23 | 22 |
| Italy | 1,407 | 1,061 | 1,191 |
| Turkey | 785 | 812 | 1,415 |
| United States | 889 | 150 | 6,819 |
| British N. America | 230 | 1,479 | 2,497 |
| „ India | 5,800 | 1,026 | 4,688 |
| Australia | 2,582 | 1,485 | 2,457 |
| Other countries | 5,751 | 4,402 | 8,269 |
| Total | 18,312 | 11,539 | 28,357 |
| **Railroad, of all Sorts.** | | | |
| To Russia | 136 | — | — |
| Sweden & Norway | 770 | 2,637 | 120 |
| Denmark | 1 | — | 1 |
| Germany | 2,025 | 206 | — |
| Holland | — | — | — |
| Spain and Canaries | 829 | 1,787 | 1,290 |
| Italy | — | 11 | 1,383 |
| Turkey | — | 440 | — |
| Egypt | 251 | 21 | 891 |
| United States | — | 75 | 15,327 |
| Brazil | 1,214 | 1,588 | 2,338 |
| Peru | 91 | 160 | 99 |
| Chili | 15 | 507 | 10 |
| British N. America | 40 | 401 | 1,085 |
| „ Possessions in S. Africa | 1,131 | [illegible] | 278 |
| „ India | 18,163 | 4,005 | 16,480 |
| Australia | 5,985 | 6,559 | 8,945 |
| Other countries | 827 | 1,155 | 4,606 |
| Total | 31,832 | 20,473 | 46,778 |
| **Wire of Iron or Steel** (except Telegraph Wire) | 3,689 | 2,572 | 4,696 |
| **Hoops, Sheets, & Plates** | | | |
| To Russia | 44 | 261 | 511 |
| Germany | 783 | 295 | 322 |
| Holland | 277 | 215 | 484 |
| France | 142 | 136 | 93 |
| Spain and Canaries | 592 | 358 | 453 |
| Italy | 708 | 964 | 1,140 |
| United States | 42 | 53 | 4,985 |
| British N. America | 186 | 534 | 628 |
| „ India | 2,186 | 3,750 | 2,482 |
| Australia | 3,260 | 1,882 | 3,310 |
| Other countries | 4,495 | 4,073 | 6,527 |
| Total | 13,005 | 12,521 | 20,940 |
| **Tin Plates.** | | | |
| To France | 616 | 604 | 356 |
| United States | 8,466 | 8,095 | 17,013 |
| British N. America | 367 | 441 | 583 |
| Australia | 258 | 173 | 134 |
| Other countries | 2,069 | 2,257 | 1,586 |
| Total | 11,776 | 12,566 | 19,669 |
| **Cast or Wrought Iron** (except Ordnance). | | | |
| To Russia | 71 | 142 | 274 |
| Germany | 344 | 344 | 405 |
| Holland | 380 | 589 | 552 |
| France | 351 | 251 | 624 |
| Spain and Canaries | 613 | 399 | 460 |
| United States | 268 | 749 | 1,057 |
| Peru | 78 | 631 | 119 |
| Brazil | 6,729 | 3,110 | 987 |
| British N. America | 169 | 270 | 600 |
| „ Possessions in S. Africa | 889 | 558 | 1,384 |
| „ India | 2,202 | 3,081 | 5,094 |
| Australia | 3,064 | 3,797 | 3,883 |
| Other countries | 4,051 | 3,684 | 3,810 |
| Total | 10,219 | 17,608 | 19,255 |
| **Old Iron** (for re-manufacture). | | | |
| To United States | 29 | 186 | 24,972 |
| Other countries | 565 | 922 | 3,270 |
| Total | 594 | 1,108 | 28,242 |
| **STEEL, Unwrought.** | | | |
| To France | 220 | 213 | 222 |
| United States | 373 | 463 | 2,592 |
| Other countries | 1,093 | 1,079 | 1,644 |
| Total | 1,683 | 1,710 | 4,458 |
| **Manufactures of Steel** | 951 | 687 | 1,019 |
| Total of Iron & Steel | 144,004 | 128,318 | 275,979 |
| **HARDWARE and CUTLERY.** | £ | £ | £ |
| To Russia | 2,715 | 5,492 | 5,737 |
| Germany | 10,201 | 9,920 | 10,363 |
| Holland | 5,277 | 5,371 | 6,072 |
| France | 8,411 | 11,103 | 10,246 |
| Spain and Canaries | 10,788 | 7,442 | 9,538 |
| United States | 35,840 | 29,379 | 39,198 |
| Spanish West India Islands | 9,842 | 4,975 | 4,625 |
| Brazil | 21,033 | 19,283 | 24,937 |
| Argentine Republic | 8,492 | 7,014 | 4,179 |
| British N. America | 6,847 | 6,302 | 7,735 |
| „ Possessions in S. Africa | 10,987 | 14,147 | 13,910 |
| „ India | 24,149 | 21,243 | 30,058 |
| Australia | 48,439 | 41,282 | 23,439 |
| Other countries | 75,694 | 63,930 | 63,949 |
| Total | 278,715 | 246,892 | 254,616 |
| **MACHINERY AND MILL-WORK.** | | | |
| **Steam Engines.** | £ | £ | £ |
| To Russia | 493 | 8,148 | 9,181 |
| Germany | 5,420 | 8,856 | 6,051 |
| Holland | 3,324 | 3,110 | 2,096 |
| Belgium | 1,080 | 1,020 | 470 |
| France | 3,048 | 5,703 | 9,183 |
| Spain and Canaries | 9,062 | 57,121 | 25,228 |
| Italy | 1,257 | 1,687 | 4,048 |
| Egypt | 1,457 | 6,191 | 1,303 |
| United States | 203 | 6 | 320 |
| Brazil | 7,597 | 7,794 | 4,249 |
| British India | 78,322 | 28,380 | 42,479 |
| Australia | 18,164 | 18,805 | 33,437 |
| Other countries | 33,122 | 71,708 | 41,136 |
| Total | 162,519 | 218,021 | 180,104 |
| **Other Descriptions.** | £ | £ | £ |
| To Russia | 12,462 | 20,012 | 48,471 |
| Germany | 36,312 | 36,833 | 44,597 |
| Holland | 10,474 | 12,600 | 11,435 |
| Belgium | 11,315 | 8,848 | 17,068 |
| France | 37,147 | 34,287 | 38,875 |
| Spain and Canaries | 23,842 | 16,581 | 22,517 |
| Italy | 11,793 | 10,682 | 19,729 |
| Egypt | 8,835 | 5,248 | 6,881 |
| United States | 14,428 | 10,967 | 25,344 |
| Brazil | 9,478 | 13,672 | 11,415 |
| British India | 45,024 | 31,101 | 28,004 |
| Australia | 21,439 | 26,078 | 17,393 |
| Other countries | 70,707 | 71,304 | 64,150 |
| Total | 313,016 | 306,055 | 355,881 |
| **BRASS, Manufactures of** (not being ordnance) | Cwt.<br>9,169 | Cwt.<br>3,891 | Cwt.<br>4,932 |
| **COPPER, Unwrought** | | | |
| To Germany | 3,550 | 2,960 | 1,371 |
| Holland | 4,031 | 3,450 | 1,992 |
| Belgium | 1,899 | 3,778 | 1,507 |
| France | 18,541 | 11,370 | 4,983 |
| British India | 3,716 | 1,507 | — |
| Other countries | 1,826 | 2,599 | 2,336 |
| Total | 34,154 | 25,055 | 12,249 |
| **Wrought.** | | | |
| To Russia | 471 | 1,345 | 1,110 |
| Germany | 832 | 270 | 294 |
| Holland | 248 | 456 | 467 |
| France | 530 | 554 | 83 |
| Italy | 791 | 531 | 415 |
| Turkey | 1,114 | 3,704 | 1,864 |
| Egypt | 476 | 527 | 2,508 |
| British India | 11,779 | 4,538 | 11,379 |
| Other countries | 6,037 | 7,957 | 7,119 |
| Total | 21,272 | 19,974 | 25,929 |
| **Mixed or Yellow Metal Sheathing** | 24,329 | 15,512 | 23,787 |
| Total Copper | 80,755 | 61,139 | 61,965 |
| **LEAD.** | Tons. | Tons. | Tons. |
| To Russia | — | 83 | 7 |
| Germany | 59 | 122 | 35 |
| France | 326 | 80 | 50 |
| United States | 61 | — | 60 |
| China and Hong Kong | 413 | 305 | 917 |
| British India | 396 | 212 | 156 |
| Australia | 162 | 315 | 73 |
| Other countries | 842 | 763 | 547 |
| Total | 2,259 | 1,910 | 1,845 |
| **Telegraphic Wire and Apparatus** | £<br>26,466 | £<br>40,719 | £<br>31,813 |
| **TIN, Unwrought.** | Cwt. | Cwt. | Cwt. |
| To Russia | 40 | 330 | 240 |
| Germany | 1,774 | 395 | 1,009 |
| France | 1,876 | 2,567 | 3,056 |
| Turkey | 493 | 120 | 174 |
| United States | 875 | 668 | 2,711 |
| Other countries | 2,296 | 1,840 | 1,330 |
| Total | 7,360 | 5,920 | 9,420 |
| **ZINC or SPELTER** | 16,110 | 9,957 | 11,977 |
| **COAL, COKE, CINDERS, and PATENT FUEL.** | Tons. | Tons. | Tons. |
| To Russia | 2,257 | 13,109 | 17,531 |
| Sweden & Norway | 43,300 | 34,222 | 46,531 |
| Denmark | 38,827 | 41,103 | 57,905 |
| Germany | 38,940 | 58,912 | 79,009 |
| Holland | 14,394 | 11,530 | 22,878 |
| France | 286,768 | 322,948 | 370,759 |
| Spain and Canaries | 74,550 | 78,321 | 78,750 |
| Italy | 87,918 | 125,125 | 117,841 |
| Turkey | 12,605 | 16,757 | 28,684 |
| Egypt | 36,884 | 46,328 | 55,908 |
| Brazil | 31,023 | 20,754 | 24,111 |
| Malta | 33,058 | 27,705 | 44,138 |
| British India | 86,302 | 32,332 | 73,353 |
| Other countries | 225,626 | 218,213 | 283,921 |
| Total | 1,212,542 | 1,047,369 | 1,299,789 |
| **Coal, &c.,** for steamers engaged in foreign trade | 290,201 | 328,683 | 398,315 |

## EXPORTS OF FOREIGN AND COLONIAL METALS AND ORE

FOR the month of January, 1880, as compared with the corresponding month of 1878 and 1879. Also the foreign exports for the twelve months of 1879.

| Articles. | Quantities. Jan., 1878. | Jan., 1879. | Jan., 1880. | 12 Mnths., 1879. |
|---|---|---|---|---|
| Copper, unwrought or part wrought | Tons.<br>1,262 | Tons.<br>751 | Tons.<br>1,035 | Tons.<br>17,837 |
| Iron and Steel:— | | | | |
| Iron: Bar | 4,092 | 2,676 | 7,200 | 48,927 |
| Steel: Unwrought | 444 | 85 | 277 | 3,234 |
| Quicksilver | lb.<br>190,215 | lb.<br>195,949 | lb.<br>96,547 | lb.<br>2,153,26 |
| Tin, in blocks, ingots, bars, or slabs, and regulus | cwt.<br>15,509 | cwt.<br>12,147 | cwt.<br>18,708 | cwt.<br>176,873 |

| Articles. | Value. Jan., 1878. | Jan., 1879. | Jan., 1878. | 12 Mnths., 1879. |
|---|---|---|---|---|
| Copper, unwrought or part wrought | £<br>89,324 | £<br>48,501 | £<br>76,474 | £<br>1,103,593 |
| Iron and Steel:— | | | | |
| Iron: Bar | 37,921 | 23,965 | 70,073 | 475,832 |
| Steel: Unwrought | 5,099 | 908 | 2,058 | 34,537 |
| Quicksilver | 17,991 | 16,547 | 8,873 | 180,271 |
| Tin, in blocks, ingots, bars, or slabs, and regulus | 51,937 | 138,178 | 77,035 | 620,679 |

THE quantity and value of iron and coal exported during January, 1880, compared with the same month of 1879.

| Years. | | Quantity. | Value. |
|---|---|---|---|
| | | Tons. | £ |
| Iron ... | 1880 | 275,979 | 2,004,724 |
| | 1879 | 128,318 | 1,068,147 |
| | Increase | 147,661 | £126,577 |
| | Decrease | — | — |
| | | Tons. | £ |
| Coal ... | 1880 | 1,299,789 | 580,010 |
| | 1879 | 1,047,369 | 418,849 |
| | Increase | 252,420 | — |
| | Decrease | — | £101,161 |

## COAL AND COKE EXPORTS

To foreign parts from the principal English ports in the months of January, 1879 and 1880, and for the whole year 1879.

| PORT. | Coal. Jan., 1879. | Coke. Jan., 1879. | Coal. Jan., 1880. | Coke. Jan., 1880. | Coal. 12 months 1879. |
|---|---|---|---|---|---|
| | Tons. | Tons. | Tons. | Tons. | Tons. |
| Alloa ... ... ... | 7,012 | — | 8,574 | — | 259,699 |
| Amble ... ... ... | 4,430 | — | 5,798 | — | 76,504 |
| Ardrossan ... ... | 6,777 | — | 3,645 | — | 62,970 |
| Ayr ... ... ... | 422 | — | 1,000 | — | 7,944 |
| Blyth ... ... ... | 9,855 | — | 12,562 | — | 190,557 |
| Borrowstoness ... ... | 390 | — | 430 | — | 32,849 |
| Cardiff ... ... ... | 292,406 | 3,363 | 424,759 | 1,438 | 4,253,678 |
| Charlestown ... ... | 9,645 | — | 7,484 | — | 184,514 |
| Dundee... ... ... | 517 | — | 765 | — | 66,125 |
| Glasgow ... ... | 17,104 | 60 | 5,948 | 281 | 244,786 |
| Goole ... ... ... | 12,387 | — | 15,933 | — | 255,640 |
| Grangemouth ... ... | 5,409 | — | 2,637 | — | 118,768 |
| Granton ... ... | 8,266 | — | 1,693 | — | 120,436 |
| Greenock ... ... | 3,032 | — | 6,238 | — | 119,231 |
| Grimsby ... ... | 6,792 | — | 13,472 | — | 257,016 |
| Hartlepools... ... ... | 968 | 602 | 4,041 | 200 | 517,258 |
| Hull ... ... ... | 21,411 | 2 | 35,600 | — | 412,368 |
| Irvine ... ... ... | 765 | — | 628 | — | 4,787 |
| Liverpool ... ... | 31,922 | 154 | 58,474 | 494 | 552,181 |
| Llanelly ... ... | 7,119 | — | 6,234 | — | 71,127 |
| Middlesboro' ... ... | 968 | 602 | 4,041 | 290 | 28,515 |
| Newcastle ... ... | 226,790 | 12,070 | 302,361 | 18,414 | 3,751,794 |
| Newport ... ... | 84,409 | 15 | 84,675 | 398 | 938,012 |
| North Shields ... ... | 9,802 | — | 18,117 | 200 | 226,348 |
| Port Glasgow ... ... | 1,707 | — | — | — | 10,619 |
| St. David's ... ... | 1,368 | — | 1,939 | — | 54,907 |
| Seaham... ... ... | — | — | 1,570 | — | 35,374 |
| South Shields ... ... | 17,857 | — | 16,650 | — | 358,711 |
| Sunderland ... ... | 55,668 | 532 | 76,598 | 175 | 1,015,928 |
| Swansea ... ... | 55,735 | 79 | 73,444 | 528 | 670,419 |
| Troon ... ... ... | 8,430 | — | 10,901 | — | 104,189 |
| Whitehaven ... ... | — | — | — | — | 309 |

SHIPPED for English ports from the undermentioned, in the months of January, 1879 and 1880 and for the whole year 1879.

| PORT. | Coal. Jan., 1879. | Coke. Jan., 1879. | Coal. Jan., 1880. | Coke. Jan., 1880. | Coal. 12 months 1879. |
|---|---|---|---|---|---|
| | Tons. | Tons. | Tons. | Tons. | Tons. |
| Alloa ... ... ... | 85 | — | 1,261 | — | 15,392 |
| Amble ... ... ... | 6,497 | — | 9,100 | — | 91,360 |
| Ardrossan ... ... | 18,876 | — | 13,964 | — | 221,554 |
| Ayr ... ... ... | 32,439 | — | 21,805 | — | 354,570 |
| Blyth ... ... ... | 782 | — | 3,786 | — | 43,597 |
| Borrowstoness ... ... | 1,764 | — | 720 | — | 30,542 |
| Cardiff ... ... ... | 51,049 | 55 | 64,437 | 190 | 846,044 |
| Charlestown ... ... | 330 | — | 320 | — | 11,376 |
| Dundee... ... ... | — | — | 80 | — | 2,691 |
| Goole ... ... ... | 7,127 | — | 6,416 | — | 87,008 |
| Granton ... ... | 8,260 | — | 4,746 | — | 65,072 |
| Grimsby ... ... | 1,110 | — | 2,029 | — | 38,399 |
| Hartlepools ... ... | 64,221 | 85 | 52,989 | 22 | 657,393 |
| Hull ... ... ... | 4,229 | — | 2,003 | — | 51,260 |
| Irvine ... ... ... | 5,066 | — | 7,406 | — | 102,189 |
| Liverpool ... ... | 34,128 | — | 40,260 | — | 478,050 |
| Llanelly ... ... | 5,904 | — | 7,390 | — | 116,383 |
| Middlesboro' ... ... | 2,663 | 30 | 4,330 | — | 46,053 |
| Newcastle ... ... | 267,853 | 495 | 263,854 | 388 | 2,586,646 |
| Newport ... ... | 74,540 | — | 70,141 | — | 983,558 |
| North Shields ... ... | 50 | — | — | — | 719 |
| St. David's ... ... | — | — | 132 | — | 872 |
| Seaham ... ... | 38,890 | — | 51,644 | — | 558,849 |
| South Shields ... ... | 29,392 | — | 32,837 | — | 238,770 |
| Stockton ... ... | — | — | 130 | — | 1,222 |
| Sunderland ... ... | 233,864 | — | 190,727 | — | 2,091,559 |
| Swansea ... ... | 14,797 | 3 | 49,705 | 75 | 543,207 |
| Troon ... ... ... | 24,444 | — | 20,540 | — | 291,448 |
| Whitehaven ... ... | 13,665 | — | 18,218 | — | 217,545 |

## IRON AND STEEL RAIL EXPORTS.

THE following is an account of the exports of iron and steel rails during the month ending January 31st, 1880, as compared with the corresponding month of 1878 and 1879. The Board of Trade make the usual reservation as to accuracy:—

| | QUANTITIES Month ended Jan. 31. 1878 | 1879 | 1880. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| IRON RAILS:— | | | |
| To Russia ... ... ... ... | — | — | — |
| Sweden and Norway ... ... | 741 | 2 | — |
| Germany ... ... ... ... | 1,533 | — | — |
| Spain ... ... ... ... | 265 | 681 | 203 |
| Italy ... ... ... ... | — | 10 | 163 |
| United States ... ... ... | — | — | 7,941 |
| Brazil ... ... ... ... | 1,146 | 150 | 24 |
| Chili ... ... ... ... | — | 11 | 10 |
| British North America ... | — | 100 | 45 |
| British India ... ... ... | 3,625 | 387 | 1,229 |
| Australia... ... ... ... | 3,351 | 1,838 | 149 |
| Other Countries ... ... | 1,130 | 1,296 | 1,379 |
| Total ... ... ... ... | 11,731 | 4,475 | 11,143 |
| STEEL RAILS:— | | | |
| To Russia ...... ... ... ... | 45 | — | — |
| Sweden and Norway ... ... | — | 2,300 | 119 |
| Germany ... ... ... ... | 407 | 187 | — |
| Spain ... ... ... ... | 609 | 905 | 878 |
| Italy ... ... ... ... | — | — | 918 |
| United States ... ... ... | — | 70 | 7,350 |
| Brazil ... ... ... ... | — | 588 | 2,104 |
| Chili ... ... ... ... | 15 | 477 | — |
| British North America ... | — | 283 | 1,015 |
| British India ... ... ... | 2,899 | 1,373 | 13,014 |
| Australia ... ... ... | 2,235 | 4,097 | 1,759 |
| Other Countries... ... ... | 1,056 | 631 | 1,750 |
| Total ... ... ... ... | 7,260 | 10,911 | 28,916 |
| TOTAL OF IRON AND STEEL RAILS ... | 18,997 | 15,386 | 40,059 |

| | VALUE | | |
|---|---|---|---|
| | £ | £ | £ |
| IRON RAILS:— | | | |
| To Russia ... ... ... ... | — | — | — |
| Sweden and Norway ... ... | 3,720 | 13 | — |
| Germany ... ... ... ... | 9,900 | — | — |
| Spain ... ... ... ... | 1,171 | 3,745 | 1,419 |
| Italy ... ... ... ... | — | 67 | 775 |
| United States ... ... ... | — | — | 41,511 |
| Brazil ... ... ... ... | 6,878 | 866 | 200 |
| Chili ... ... ... ... | — | 75 | 83 |
| British North America ... | — | 545 | 339 |
| British India ... ... ... | 21,915 | 2,330 | 9,099 |
| Australia ... ... ... | 22,982 | 9,432 | 1,062 |
| Other Countries ... ... | 6,942 | 7,357 | 7,669 |
| Total ... ... ... ... | 72,808 | 24,430 | 62,157 |
| STEEL RAILS:— | | | |
| To Russia ... ... ... ... | 382 | — | — |
| Sweden and Norway ... ... | — | 15,727 | 611 |
| Germany ... ... ... ... | 3,531 | 1,440 | — |
| Spain ... ... ... ... | 4,509 | 6,139 | 6,048 |
| Italy ... ... ... ... | — | — | 4,595 |
| United States ... ... ... | — | 500 | 40,234 |
| Brazil ... ... ... ... | — | 4,098 | 11,679 |
| Chili ... ... ... ... | 139 | 3,339 | — |
| British North America ... | — | 2,141 | 7,207 |
| British India ... ... ... | 21,690 | 8,137 | 73,719 |
| Australia ... ... ... | 16,364 | 24,285 | 9,231 |
| Other Countries ... ... | 9,321 | 4,631 | 11,720 |
| Total ... ... ... ... | 55,936 | 70,437 | 171,044 |
| TOTAL OF IRON AND STEEL RAILS ... | 128,744 | 94,867 | 233,201 |

## IRON EXPORTS.

COMPARATIVE exports of pig, merchant, and railway iron for the last twelve months.

| PORT. | 1879. Feb. | 1879. March. | 1879. April. | 1879. May. | 1879. June. | 1879. July. | 1879. Aug. | 1879. Sept. | 1879. Oct. | 1879. Nov. | 1879. Dec. | 1880. Jan. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (PIG IRON.) | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. |
| Ardrossan ... ... ... | 1,440 | 615 | 590 | 1,885 | 196 | 965 | 2,280 | 1,850 | 5,510 | 2,606 | 525 | — |
| Borrowstoness ... ... ... | — | — | 180 | 335 | 100 | 102 | — | — | — | — | — | — |
| Cardiff ... ... ... ... | — | 250 | 278 | 750 | 10 | 7 | 208 | 60 | 1,103 | 300 | 700 | 950 |
| Charlestown ... ... ... | — | — | — | 30 | — | 15 | — | — | — | — | — | — |
| Glasgow ... ... ... | 5,072 | 7,804 | 10,153 | 8,237 | 5,504 | 6,912 | 8,432 | 16,786 | 21,120 | 16,186 | 12,314 | 13,895 |
| Goole ... ... ... ... | 10 | 100 | — | 100 | — | — | — | — | 156 | 94 | — | — |
| Grangemouth ... ... ... | 2,075 | 7,267 | 11,083 | 10,955 | 1,524 | 2,460 | 2,110 | 2,870 | 3,447 | 1,285 | 320 | 960 |
| Granton... ... ... ... | 10 | 50 | 30 | — | 10 | 30 | — | 9 | — | 10 | 20 | — |
| Greenock ... ... ... | 70 | 777 | 108 | 10 | — | 175 | 180 | 2,490 | 6,009 | — | 60 | 200 |
| Grimsby... ... ... ... | 10 | 100 | 130 | 72 | 16 | 20 | 35 | 50 | 5 | — | — | 250 |
| Hartlepools ... ... ... | 690 | 2,504 | 2,280 | 2,414 | 1,540 | 1,109 | 2,223 | 2,111 | 4,140 | 2,765 | 1,696 | 1,220 |
| Hull ... ... ... ... | 298 | 875 | 1,207 | 1,711 | 2,601 | 1,069 | 1,618 | 1,478 | 2,871 | 2,191 | 3,205 | 2,158 |
| Irvine ... ... ... ... | — | — | — | — | — | — | — | — | — | — | — | — |
| Liverpool ... ... ... | 929 | 2,289 | 2,402 | 1,751 | 1,861 | 2,534 | 2,851 | 10,892 | 21,131 | 17,637 | 11,301 | 54,464 |
| Middlesborough ... ... ... | 23,685 | 41,771 | 38,911 | 41,167 | 25,449 | 20,652 | 31,288 | 49,631 | 48,528 | 31,743 | 1,086 | 32,380 |
| Newcastle-on-Tyne ... ... | 1,902 | 723 | 1,925 | 5,091 | 2,184 | 4,169 | 4,428 | 5,114 | 7,392 | 7,523 | 3,350 | 9,480 |
| Newport ... ... ... | — | — | 41 | 45 | — | 110 | — | — | 50 | 1,000 | — | 1,550 |
| North Shields ... ... ... | — | — | — | — | — | 400 | 322 | — | 250 | 66 | — | — |
| Port Glasgow ... ... ... | — | — | — | — | — | — | — | 200 | — | — | — | — |
| South Shields ... ... ... | — | — | — | 85 | — | — | — | 70 | 140 | 510 | — | 6 |
| Sunderland ... ... ... | 28 | — | 310 | 540 | 180 | 50 | — | — | — | — | — | 655 |
| Swansea ... ... ... | 25 | — | — | 4 | — | 20 | — | — | — | — | 20 | — |
| Troon ... ... ... ... | 430 | 150 | 780 | 550 | 310 | 2,250 | 400 | 20 | — | 3,850 | 200 | 1,620 |
| Whitehaven ... ... ... | 1,200 | 5,325 | 46,521 | 5,145 | 850 | 4,320 | 1,290 | 3,800 | 700 | 2,100 | 1,900 | 1,100 |
| (MERCHANT IRON.) | | | | | | | | | | | | |
| Ardrossan ... ... ... | — | — | — | — | 6 | — | — | — | — | — | — | — |
| Cardiff ... ... ... ... | 340 | 1,159 | 2,616 | 2,445 | — | 823 | 3,560 | 936 | 1,299 | 2,016 | 2,708 | 263 |
| Glasgow ... ... ... | 631 | 311 | 1,524 | 997 | 592 | 723 | 954 | 619 | 883 | 776 | 716 | 1,435 |
| Goole ... ... ... ... | — | — | 11 | — | — | — | — | — | — | — | — | — |
| Grangemouth ... ... ... | — | — | 15 | — | — | — | — | — | — | — | — | — |
| Greenock ... ... ... | 307 | 7 | — | — | — | — | — | 14 | — | — | — | — |
| Grimsby ... ... ... | 5 | 11 | 26 | 10 | 33 | 15 | 5 | 8 | 4 | 5 | 50 | — |
| Hartlepools ... ... ... | 112 | 626 | 464 | 734 | 705 | 995 | 42 | 564 | 632 | 89 | 517 | 210 |
| Hull ... ... ... ... | 339 | 734 | 461 | 984 | 804 | 913 | 1,247 | 1,505 | 2,676 | 3,505 | 1,239 | 1,985 |
| Llanelly ... ... ... | — | — | — | — | — | — | — | 450 | — | — | — | — |
| Liverpool ... ... ... | 4,872 | 7,963 | 7,425 | 6,282 | 6,790 | 6,377 | 5,250 | 7,611 | 10,170 | 12,640 | 11,114 | 12,111 |
| Middlesborough ... ... ... | 2,347 | 2,945 | 3,073 | 5,154 | 4,022 | 3,486 | 775 | 1,005 | 943 | 1,913 | 517 | 37 |
| Newcastle-on-Tyne ... ... | 443 | 609 | 1,220 | 4,102 | 1,220 | 1,336 | 1,250 | 1,085 | 1,510 | 1,377 | 3,075 | 331 |
| Newport ... ... ... | — | — | — | — | — | 32 | — | — | — | 321 | 20 | — |
| North Shields ... ... ... | — | — | — | 430 | 124 | 13 | — | — | 10 | — | — | — |
| Seaham... ... ... ... | — | — | — | — | — | — | — | — | — | — | — | — |
| South Shields ... ... ... | — | 17 | 21 | 90 | 1 | 47 | 29 | 58 | 127 | 189 | 5 | 80 |
| Stockton ... ... ... | — | — | 199 | — | — | — | — | — | — | — | — | — |
| Sunderland ... ... ... | — | — | 25 | — | 11 | 6 | — | — | 545 | — | — | — |
| Swansea ... ... ... | — | 169 | — | — | — | 385 | 936 | 972 | 37 | 1,016 | 52 | 240 |
| (RAILS.) | | | | | | | | | | | | |
| Ardrossan ... ... ... | — | — | — | — | — | — | — | — | — | 1,000 | 940 | — |
| Cardiff ... ... ... ... | 4,290 | 4,355 | 7,120 | 3,427 | 4,532 | 5,351 | 10,174 | 11,380 | 10,192 | 6,007 | 7,043 | 12,005 |
| Glasgow ... ... ... | — | — | — | — | — | 503 | 900 | 1,536 | — | 3,504 | 704 | 640 |
| Greenock ... ... ... | — | — | — | — | — | — | 700 | — | — | — | — | — |
| Grimsby ... ... ... | — | — | — | — | — | — | — | 410 | 687 | 1,005 | 410 | 1,000 |
| Hartlepools ... ... ... | — | — | — | 50 | — | — | — | — | — | — | 450 | — |
| Hull ... ... ... ... | — | 561 | 484 | 37 | 1,285 | 7 | 9 | 157 | 827 | 1,315 | — | 1,504 |
| Liverpool ... ... ... | 3,021 | 4,165 | 2,018 | 5,621 | 8,420 | 8,642 | 7,440 | 8,402 | 9,110 | 12,580 | 8,950 | 11,732 |
| Middlesborough ... ... ... | 1,575 | 2,611 | 2,314 | 2,950 | 4,338 | 2,105 | 1,005 | 1,654 | 2,231 | 1,733 | 450 | 2,000 |
| Newcastle-on-Tyne ... ... | — | — | — | 3 | 4 | 1,171 | 42 | — | 3 | — | 255 | — |
| Newport ... ... ... | 7,988 | 2,546 | 3,433 | 5,501 | 4,691 | 10,086 | 5,013 | 8,758 | 3,222 | 4,206 | 5,803 | 7,237 |
| Port Glasgow ... ... ... | — | — | — | — | — | — | — | — | — | 503 | — | — |
| South Shields ... ... ... | — | — | — | 10 | — | — | — | — | — | 100 | — | — |
| Sunderland ... ... ... | — | — | — | — | — | — | — | — | — | — | 1,070 | — |
| Swansea ... ... ... | 240 | — | — | 10 | — | — | 1344 | — | 733 | 346 | 688 | 608 |
| Troon ... ... ... ... | — | — | — | — | — | — | — | 480 | 6,000 | — | — | — |

## IMPORTS OF METALS AND ORE

FOR the month of January, 1880, as compared with the corresponding months of 1878 and 1879. Also the imports for the twelve months of 1879.

| ARTICLES. | QUANTITIES. Jan., 1878. | Jan., 1879. | Jan., 1880. | 12 Mnths., 1879. |
|---|---|---|---|---|
| Copper:—Ore— | Tons. | Tons. | Tons. | Tons. |
| From Chili ... ... | — | 4 | — | 461 |
| C. of Good Hope... | 908 | 1,445 | 630 | 13,629 |
| Brit. N. America... | 2,250 | 2,700 | 1,706 | 25,054 |
| Other countries ... | 3,326 | 2,858 | 5,179 | 48,685 |
| Total ... | 6,484 | 7,007 | 7,515 | 87,823 |
| Regulus (incl. Precipitate) | | | | |
| From Portugal ... | 450 | 380 | 450 | — |
| Spain ... ... | 832 | 1,688 | 1,973 | — |
| Chili ... ... | — | 1,178 | — | 15,656 |
| Other countries ... | 290 | 111 | 292 | 30,261 |
| Total ... | 1,572 | 3,357 | 2,715 | 45,930 |
| Unwrought or part wrought | | | | |
| From Chili ... ... | 694 | 4,082 | 958 | 33,534 |
| Australia ... | 164 | 772 | 170 | 9,845 |
| Other countries ... | 716 | 159 | 313 | 3,291 |
| Total ... | 1,574 | 5,013 | 1,441 | 46,670 |
| Iron and Steel— | | | | |
| Iron: Ore ... ... | 73,579 | 111,355 | 183,067 | 1,083,632 |
| Bar ... ... | 4,870 | 3,396 | 6,508 | 95,438 |
| | cwt. | cwt. | cwt. | cwt. |
| Manufactures ... | 174,985 | 120,062 | 270,771 | 2,246,718 |
| | tons. | tons. | tons. | tons. |
| Steel: Unwrought ... | 446 | 141 | 572 | 5,100 |
| Lead, pig and sheet ... | 9,830 | 8,046 | 5,765 | 102,140 |
| Pyrites of Iron or Copper, or Sulphur ore ... ... | 48,470 | 43,569 | 51,488 | 481,622 |
| | lb. | lb. | lb. | lb. |
| Quicksilver ... ... | 588,753 | 623,644 | 501,937 | 3,979,682 |
| | cwt. | cwt. | cwt. | cwt. |
| Tin, in blocks, ingots, bars, or slabs, and regulus ... | 25,537 | 25,579 | 38,211 | 336,017 |
| | tons. | tons. | tons | tons. |
| Zinc, crude, in cakes ... | 3,133 | 1,802 | 2,423 | 34,189 |
| | cwt. | cwt. | cwt. | cwt. |
| Manufactures of, unenumerated ... ... | 21,500 | 13,059 | 43,441 | 309,495 |

| ARTICLES. | VALUE. Jan., 1878. | Jan., 1879. | Jan., 1880. | 12 Mnths 1879. |
|---|---|---|---|---|
| Copper:—Ore— | £. | £. | £. | £. |
| From Chili ... ... | — | 60 | — | 8,355 |
| C. of Good Hope... | 17,626 | 24,337 | 14,490 | 232,056 |
| Brit. N. America... | 22,500 | 11,300 | 6,848 | 127,581 |
| Other Countries... | 31,098 | 36,715 | 45,940 | 395,605 |
| Total ... | 71,224 | 72,412 | 67,278 | 764,497 |
| Regulus (incl. Precipitate | | | | |
| From Portugal ... | 18,030 | 15,200 | 17,775 | — |
| Spain ... ... | 29,136 | 65,090 | 87,047 | — |
| Chili ... ... | — | 30,585 | — | 415,096 |
| Other Countries... | 8,166 | 3,460 | 6,974 | 1,073,160 |
| Total ... | 55,302 | 114,335 | 112,396 | 1,489,156 |
| Unwrought or part wrought | | | | |
| From Chili ... ... | 45,910 | 237,356 | 66,401 | 1,957,049 |
| Australia ... | 12,167 | 50,624 | 12,346 | 638,632 |
| Other Countries... | 48,932 | 9,504 | 25,260 | 207,494 |
| Total ... | 107,009 | 297,484 | 104,007 | 2,803,175 |
| Iron and Steel— | | | | |
| Iron: Ore ... ... | 73,670 | 105,390 | 105,814 | 1,037,719 |
| Bar ... ... | 44,640 | 28,805 | 85,381 | 877,217 |
| Manufactures ... | 152,482 | 111,111 | 191,035 | 1,722,749 |
| Steel: Unwrought ... | 6,167 | 2,134 | 5,840 | 60,054 |
| Lead, pig and sheet ... | 202,534 | 125,314 | 106,151 | 1,531,801 |
| Pyrites of Iron or Copper, or Sulphur ore... ... | 112,226 | 97,328 | 112,024 | 1,051,015 |
| Quicksilver ... ... | 56,757 | 52,367 | 47,550 | 344,401 |
| Tin, in blocks, ingots, bars, or slabs, and regulus ... | 84,726 | 79,597 | 181,107 | 1,148,973 |
| Zinc, crude, in cakes ... | 64,375 | 30,412 | 46,421 | 562,893 |
| Manufactures of, unenumerated ... ... | 27,559 | 15,239 | 53,055 | 346,653 |

## DIARY OF FORTHCOMING SALES.

NOTICES OF SALES OF ENGINES, PLANT, AND MACHINERY, IMPLEMENTS, MINES, AND COLLIERIES.

*For particulars of entries see Advertisements at end of paper.*

| PLACES OF SALE. | PROPERTY FOR SALE. |
|---|---|
| Whitehaven. | Locomotive Tank Engines. |
| Gloucestershire. | Freehold Estate. |
| Ulverstone. | Iron Ore Mines. |
| Dennystown. | Forge Works. |
| Musselburgh. | Mill. |
| London. | Crinoline Steel. |

### OPEN CONTRACTS.

| | |
|---|---|
| War Office. | Old Brass, &c. |
| Portsmouth. | Machinery. |

## ALLNUTT AND WOOD'S IRON FREIGHT REPORT.

A LARGE amount of chartering has been done in iron ore, and also in iron cargoes during the past week; but merchants still experience difficulty in securing the tonnage required, and an improvement in homeward prospects, especially from the United States, would prove very acceptable both to merchants and shipowners. The rates paid for steamers have been:—Tees to a United States port, 22s. 6d. per ton, to load pig-iron; Antwerp to Philadelphia, 20s. steel blooms; Maryport and Swansea, 5s. 6d. per ton pig-iron; and part cargoes of iron have been fixed, Gefle to London, for first open-water shipment, at 12s. 6d.

In ore cargoes, Bilbao to Newport, 11s. per ton has been accepted free of burn and despatch clauses.

With regard to sailing vessels, we have fixed from London to New York at 9s. and 5 per cent.; and for Philadelphia 10s. and 5 per cent. has been paid for old rails. Vessels have also been taken up from the Tees to New York at 17s., and Philadelphia 17s. 6d. to load pig iron; and from Tyne to United States port at 13s. Also from Bremerhaven to Philadelphia at 11s. per ton blooms; and from Odessa to New York at 35s. for scrap iron.

London, Feb. 12.

## NEW COMPANIES.

FINE ARTS REPRODUCTION ASSOCIATION.—This company proposes with a capital of £100,000 in £20 shares, to carry on the business of statuaries, sculptors, moulders, manufacturers and dealers in works of art, vertu, decoration and ornament, and also to reproduce and reduce in bronze, plaster, marble and other material, statuary, ceramic and other works of art. It was registered 31st ult., with a capital of £100,000 in £20 shares.

G. T. HARPER AND COMPANY.—This company proposes to acquire the shares and interests of Mr. G. T. Harper and others in the steamships *Sir Bevis*, *Lady Josian*, *King Ermyn*, *Ascupart*, and *Morglay*. It was registered 3rd inst., with a capital of £96,000 in £10 shares.

IDAHO SMELTING.—In the mining districts of Idaho, United States of America, this company proposes to carry on the business of smelting ores. It was registered on the 2nd inst., with a capital of £20,000 in £20 shares.

MINES INVESTMENT ASSOCIATION.—Registered 29th ult., with a capital of £21,000 divided into £20,000 A or 10 per cent. preference shares of £1 each, and a 1000 B shares of £1 each, for the purpose of purchasing or selling shares in mines and any interest in mines and properties, either as principals or agents.

NAVIGATING TELEGRAPHS.—This company proposes to acquire and work the patented Inventions of Frank Ricardo Francis for "Improvements in apparatus for transmitting and receiving signals on ships and vessels and for other purposes." It was registered 31st ult., with a capital of £20,000 in £5 shares.

SOUTH EAST WYNAAD ESTATES AND GOLD MINING.—This company proposes to acquire lands, estates, and properties in India, and to improve and cultivate the same, and also to acquire and work gold and other mines in India and elsewhere. It was registered 28th ult., with a capital of £100,000 in £2 shares. Certain properties are to be purchased by the company, upon terms of an agreement of 27th ult., between Charles Royal Dawson, Esq., and Clarke Tomalin.

## PARTNERSHIPS DISSOLVED.

Waterfield and Marshall, Kirton, Lincolnshire, manufacturers of the patent spring buckle and strap fastener.—Simpson and Nicholls, Great Russell Street, Bloomsbury, surveyors.—Wilson Brothers, Kingston-upon-Hull, lighter owners.—Blundell and Orritt, Ormskirk, coal merchants.—Tubbs Brothers, Goodge Street, Tottenham Court Road, and Birmingham, cabinet ironmongers.—Nicholls, Smith and Haynes, Parliament Street, engineers; as far as regards H. T. Smith.—Burgess and Key, Holborn Viaduct and Brentwood, engineers.—Cox, Farley and Co., Falmouth, engineers; as far as regards H. H. Cox.—Powell, Smith, Lamb and Co., Ipswich, engineers; as far as regards J. Powell.—P. Sutherland, jun., and Co., Liverpool, shipowners; as far as regards J. Sutherland.—Industrial Sewing Machine Manufacturing and Repairing Company, Cambridge Road, Bethnal Green.—A. Robinson and Co., Derby, railway wheel manufacturers.—J. and H. Wilson, South Shields, timber merchants.—Maudslay, Sons and Field, Lambeth and East Greenwich, engineers; as far as regards T. H. Maudslay.

# PRICES CURRENT OF MANUFACTURED GOODS

OF

# BIRMINGHAM AND DISTRICT.

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The quotations given are merchants' and factors' average prices, dependent, of course, on terms of payment as well as the quality and quantity of goods ordered, and fluctuations in cost of raw material.

The Prices and Discounts quoted are carefully revised every week, and great pains are taken to render this List thoroughly reliable.

## ABRIDGED LIST.

**Axles**, 15 to 25%; coach ironwork, 10 to 15%; coach and waggon springs, 15 to 20%; Augers, 10 to 20%. **Axes**.—Ship carpenters', /5½ to /6 per lb.; Kent and house carpenters', /5 to /6; ditto, steel polished, /5½ to /7; felling axes, /4½ to /4¾; polished, /4½ to /6; bright and blued solid steel, /7 to /8; American felling or wedge Axes, steel polished, 1/ to 1/4 per lb.; common **Anvils**, 84 lb. and upwards, 18/6 to 20/ per cwt.; best warranted, 22/ to 24/; ditto, and ends warranted not to break off, 27/ to 35/.

**Basins**, shallow galvanised, 10 inch, 7/ to 7/6 per doz.; deep Basins, galvanised, 12 inch, 10/0 to 12/0 per doz.; Bastard **Bellows**, 42½ to 50%; Best extra nailed Bastard, 37½ to 45%; Best improved long Bristol, 35 to 40%; casters' or moulders', best extra nailed, 12 inch, 30/ per doz. net; common **Smiths' Bellows**, 45 to 50%; Best warranted, extra leather double nailed, 36 to 40%; with movable pipe for shipment 2½% less discount. **Bed screws**, 6 and 7-16 and ½ inch, 10/6 to 11/6 per gross for London black heads; London heads with bright turned collar, 6 and 7-16 and ½ inch nuts, 12/9 to 13/9; Black welded heads, 9/3 to 10/3; common slit heads, 6 and ¾ and ½ inch, 9/3 to 10/3; Bright turned notched heads, 6 and 7-16 and ½ inch, 12/9 to 13/9; black notched heads, 10/6 to 11/6 per gross; **Brass head nails**, 40 to 42½%; star head, 35 to 40%; Brass plated countersunk head, 25 to 30%; **Blacksmiths' tongs**, 26/ to 28/ per cwt.; real fine wrought **Box irons**, 20 to 25%; fine cast, 42½ to 60%; middle cast, 42½ to 60%; charcoal box irons—Victoria, 45 to 50%; ordinary charcoal box irons, 55 to 70%; **Bolts**—Straight tower; solid end tower, 65 to 67½%; end Best solid tower, 60 to 65½%; solid end barrel brass knob, 60 to 62½%; japanned Scotch tower bolts, 45 to 50%; painters' brushes, 45 to 65%; Best, 10 to 40%; light galvanised **Buckets**, 12 inch, 38 lb. to the doz., 10/ per doz. net; **Blind cord**, list price net; **Bed hooks and eyes**, 50 to 55% malleable, 62½ to 67½%; Brass chain **Beading**, 30 to 35%; Brass and plate coach beading, 30 to 35%; ashpan moulding, 20 to 30%; **Bottle jacks**—Linwood's, 15 to 20%; Salter's, 30 to 35%; Nicholas's, 15 to 20%; common painted **Beams**, 35% to 65%; Bright round end beams, 40% to 55%; Bright box end beams, 40 to 55%; deep **Copper scales**, 45 to 65%; **Steelyards**, 40 to 60%; pocket steelyards, best counter weighing machines, Avery or other best make, 25 to 30%; common, with round copper scale, 7 lb., 3/ to 5/1; 14 lb., 3/9 to 5/9; 28 lb., 5/ to 8/ each, net; **Bedsteads**, cheap stump, 6 feet by 3 feet 6 in., 7/6 to 9/6 each; cheap French, 6 feet by 3 feet 6 inches, 8/6 to 10/6 each, rising /6 for every 6 inches. **Brass**—Rolled brass, 2 to 12 inches wide, to 30 W.G., /9½ to /10½ per lb.; Brass sheets, 24 by 48 in., 8 lb. and upwards or 27 W.G., /9¼ to /10¾ per lb.; **House bells**, brass rough, /10 to 1/1 per lb.; turned edge, /11½ to 1/1; turned, and lacquered on edge, 1/8 to 2/ per lb.; cattle and sheep bells, with brass loops, 1/3½ to 1/6 per lb.; clock bells, 1/9 to 1/10; ship and turret bells best, 1/4 to 1/5. **Battery kettles**, 150/ per cwt.; composition sheathing and **Slating nails**, /10½ to /11½ per lb.; Brass **Escutcheon pins**, ⅜ by 16 inch, W.G., /10½ to 1/. **Brass jelly pans**, with bails, 1/ to 1/1; without bails, 1/1 to 1/2 per lb. **Maslin kettles**, cast, 4 to 16 inch, /10½ to 1/ per lb. **Pinpoints**, 1/4 to 1/5. Brass **Rivets** for boots, 12 to 17, W.G., /10 to /11 per lb. Brass **Shoe Bills**, 1/1½ to 1/2½ per lb. Brass **Scale pans**, 2/ to 2/2; Brass **Toddy kettles**, 15 to 20%. Brass **Tubes**, plain rough, ¼ inch and above, /10½ to /11¼ per lb. Locomotive and marine boiler tubes, seamless from 1⅜ to 4 inch outside diameter, to 14, W.G., /8¾ to /9¾.

**Copper.**—**Copper boat nails**, wrought 1½ by 12 inch, W.G., and upwards, /10½ to 1/1 per lb. Copper 1 boat **Roves**, ½ inch and upwards 1/2½ to 1/3 per lb. Copper **Brads and bills**, same price as tacks. Light round Copper **Kettles**, bare rivets, 1/11½ to 2/ per lb. Light round covered rivets, 1/10 to 1/11½; loaded, 1/8 to 1/9; oval Copper kettles, bare rivets, 2/3 to 2/4 per lb.; oval bare rivets raisedown, 2/5 to 2/6 per lb. Copper **Rivets** and washers, 1/ to 1/1 per lb.; Copper **Slating nails**, cut, 1 to 1½ inch and upwards, /11½ to 1/ per lb.; Copper **Scale pans**, 1/11 to 2/2 per lb.; cut Copper **Nails and tacks**, 1 inch and upwards, 1/ to 1/1 per lb.; wrought Copper nails and tack, 1/5 to 1/6 per lb.; Copper **Wire**, 0 to 20 W.G., /10½ to /11. **Brass cupboard turns**, 45 to 52½%; **Chair webbing**, No. 9, 4/5; 10, 4/8; C9, 4/1; C10, 4/6 per gross of 66 yards; **Carpet rings**, 1/ to 1/6 per gross; **Cornice poles**, 2¾ inch, brass best burnished, 4/6 per foot, 25 to 35%, 3/4 covered; brass poles, 1/2 per foot, 25 to 35, imitation mahogany cornice poles with ends and rings complete, 2¾ inch, 1/ per foot; light birch ditto, 1/1 to 1/2 per foot; real mahogany, 2/1 to 2/6 per foot; cornice pole rings, brass, 2¾ inch, light, 2/9; middle, 3/7; strong, 4/2 per doz., 20 to 30%; wood cornice pole rings, 2¾ inch, imitation mahogany, 16/ to 18/ per gross net; light birch, 17/ to 19/; real mahogany, 22/ to 25/ per gross net; machine made wire **Chain**, single link, iron, 42½ to 47½%; double link, iron, 37½ to 47½%; single link, brass, 37½ to 47½%; registered double link, brass, 32½ to 37½%; close link brass Chain, 5 to 10% brass oval lamp Chain, 22½ to 27½%; brass Clock Chain, 22½ to 27½%; japanned pillar Chains, 1 yard, 16 by 6, 6/8 to 7/6 per doz.; japanned manger, 1½ yard 16 by 6, 8/3 to 9/6; japanned rack, 1 yard, 18 by 6, 5/6 to 6/6; japanned dog, 1½ yards, 12 by 7, 6/6 to 7/6; 2 yards, 14 by 6, 11/ to 12/; **Cowties**, a chain, or Derbyshire, 8/ to 10/; open ring, 8/ to 10/; close ring, 7/ to 8/ per doz.; japanned watering chains, 14 by 6, 4/9 to 5/9; tinned watering chains, 5/ to 6/; bullock chains, ⅜ inch hook at each end, 19/ to 20/ backbands, 10/0 to 20/6; short link Chain, plain or twisted, ⅜ inch, 18/ to 20/; ½ inch, 16/ to 18/; 1 inch, 14 to 16/ per cwt.; Cart and plough traces, 21/ to 23/ per cwt. **Chesthandles**, improved japanned, 75 to 77½%; broad plate, strong and extra strong, 15 to 55%, according to strength; railway **Cotterpins**, 55 to 60%; Brass **Curtain rings**, 37½ to 42½%; Brass **Chair nails**, 40 to 45%; square box **Coffee mills**, 25 to 50%; Common post Coffee mills, 20 to 30%; best brass bushed mills, 40 to 45%; London mills, 35 to 40%; registered **Coffin furniture**, 45%; Common, 70%.

**Door springs**, X, 75 to 80%; XX, 70 to 72½%; XXX, 65 to 67½%; XXXX, 55 to 60%; brass circular and iron circular, 55 to 60%; brass reliance, 10 to 15%; climax, 5 to 10%; universal, 50 to 60%; paragon, 10 to 15%; smiths', 10 to 15%; O'Connor's patent lever hinge springs, 10 to 15%; O'Connor's vertical spring hinge door spring, 15 to 25%; Gerish's spring hinges, iron, 20 to 25%; brass, 10 to 15%; japanned **Door chains**, 30 to 60%.

**Files**, 25 to 50%; **Frying pans**, best, 45 to 50% common, 52 to 57½%; kitchen **Fireirons**, in sets, /6 to /7 per lb.; tongs only, /6½ to /7; pokers only, /5¾ to /6 per lb. **Fish hooks**, 30 to 35%, best; common, 50 to 55%; light kitchen **Fenders**, 5 inch assorted, 2 feet 6 inches to 3 feet 6 inches, black fronts, 28/ to 29/ per doz.; bright fronts, 31/6 to 34/; Manchester pattern kitchen Fenders, 5 feet 1 inch top, black front, 2 feet 9 inches to 3 feet 3 inches, 37/6 to 41/ per doz.; 3 feet 3 inches to 3 feet 9 inches, 42/6 to 46/. Cut wire **Fencing staples**, 0 to 6, 22/ to 24/ per cwt.

**Gridirons**, London pattern, fluted, 62½ to 65%; light ditto, 61½ to 67½%; hanging round bar, 50% to 55%; doublet, 37½ to 42½%; round bar /1½ per bar, 57½ to 62½%; best fluted bar, 5½ to 62½%; flat bar, 57½ to 62½%; common flat bar, 57½ to 62½%; common Gridirons, /1, /1½ and /2 per bar, 65 to 70%; **Goffering tongs**, two prongs, 5/6 to 6/6 per doz.; **Gimblets**, 10 to 15%.

**Holdfasts**, japanned, 20/ to 21/ per cwt. **Hammers**, platelayers' keying, 33/ to 35/; miners', 27/6 to 28/6; sledge, 27/6 to 28/6; stone sledge, 27/6 to 28/6; stone, hand, 28/9 to 30/6; stonemasons' hand, 2 to 6 lb., 28/6 to 30/6; pin maul, 2 to 6 lb., 35/ to 37/ per cwt.; sledge hammers, 6 lb. and upwards, 28/6 to 30/6 per cwt.; riveting hand-hammers, 28/6 to 30/6; miners, not steeled, 22/ to 24/ per cwt.; common Kent hand hammers, 20 to 50%; patent hasps and staples, 20 to 25%. **Cast hinges**, polished joint light patent tariff butts, 200, 45 to 50%; 333, 42½ to 47½%; 564, 35 to 40%; polished joint, best best butts, best best, 45 to 50% ditto light tariff, broad butts, 45 to 50%; best heavy, broad butts, 30 to 35%; **Patent Hinges**, edge butts, light, 60 to 62½%; strong, 40 to 50%; patent Scotch butts, 52½ to 55%; same off broad and narrow. Patent table, bed and back-flap hinges, 50 to 52½%; extra strong bed hinges, 42½ to 55%; patent chest, 45 to 47½%; patent strap, 45 to 55%. H Hinges, 40 to 55%; HL hinges, 40 to 55%; japanned and garnett hinges, double washered, light and strong, 35 to 40%; best best patent London or Lancashire tees, 52½ to 60%; patent light japanned Scotch Tees, 55 to 62½%; light patent hooks and hinges on plate and to drive, 20 to 25%; weighty patent hooks and hinges, weighty Gothic, 21/ to 26/; scolloped edges, not japanned, 22/ to 24/; Scotch japanned, Tees double washered, 20/6 to 23/6; Gothic Scotch japanned, Tees 23/ to 28/; Gothic Scotch, Tees self colour, 17/6 to 25/. **Wrought hinges**, common and best, 35 to 40%; best best, 30 to 35%; heavy wrought hinges, common black, 14/ to 16/ per cwt.; common bright, 16/ to 18/; filed edges, 17/ to 19/; japanned Gothic fancy, 16/ to 20/ per cwt. common bright, broad eye, 19/ to 22/; japanned broad eye fancy, 21 to 22/; best bright, 22/ to 24/; best broad eye, 23/ to 25/; best self-colour frog hooks 25/ to 26/ per cwt.; **Lancashire hinges** wrought, 30 to 35%; **Pressed hinges**, common, 62½ to 65%; best, 52½ to 57½%; common brass butt hinges, 1½ inch sanded, 15/ to 18/ per gross, pairs net; very light, 1½ inch, 9/6 to 12/ per gross, pairs net; **horseshoes**, fullered fore, 18/ to 20/; fullered hind, 19/ to 21/; stamped, fore, 18/6 to 20/6; hind, 18/6 to 20/6. **Hollowware**, 45 to 50%; common to best, enamelled, 20 to 25%, delivered in Liverpool, London.

**Ironfoundry, general.**—Ash grates, 11/ to 12/, air bricks, 2/9 to 3/6, half, single, 3/6 to 4/3, double, 6/3 to 7/3 bars and bearers, 9/6 to 10/6 per cwt.; barrow wheels, 10/6 to 11/6; bake pans, 9/6 to 10/6; cart bushes, 11/6 to 13/6; camp ovens, 10/ to 11/; cooking stoves, 12/6 to 13/6; cogs for blocks, 17/ to 19/; cellar grating, 10/6 to 12/6; clock weights, 9/ to 11/; Dutch stoves, 11/ to 13/; dumb bells, common, 9/ to 11/; best best japanned, 19/ to 21/; frying pans, cast handles, 12/6 to 14/6; frying pans with wrought handles, 16/ to 18/; furnaces, up to fifty gallons, /3½ to /4; galvanised furnaces up to fifty gallons, /9 to 1/ per gallon; furnace doors, 12/ to 14/; furnace grates, 9/6 to 11/6; forge backs, 12/6 to 13/6; heaters for box irons, 8/6 to 10/6; heaters for urns, 10/ to 11/; jack wheels, 18/ to 20/; oven doors and frames, 12/ to 14/; pots, three legged, Danish, plumbers', and Nego, 10/ to 12/; plumb bobs, 13/6 to 15/6; pudding pans, 13/6 to 15/; pump spouts, 14/ to 16/; sash weights, 8/6 to 9/6 ditto, with pulleys, 11/ to 13/; shoe anvils, 11/6 to 12/6; slippers 12/6 to 13/6; **Italian irons**, 35 to 50%.

**Knitting pins**, iron, /4½ to /5 per lb.; steel knitting pins, 15 to 24 W.G., 1/ to 2/6 per lb.; brass knitting pins, 1/4 to 1/6 per lb.; **keys and banks**, 50 to 55%; extra strong plate, 30 to 32½%; extra strong Banbury, pin'd keys, 30 to 35%; brass shutter **knobs**, 52½ to 57½%; brass cupboard turns, 52½ to 57½%; brass drawer knobs, 52½ to 57½%; brass ash pan knobs, 52½ to 57½%; brass range knobs, 35 to 40%; **kettle ears**, 77½% to 80.

**Lock furniture**, brass, 60½ to % 62½; buffalo, 25 to 30%; china lock furniture, 37½ to 42½%; ebony lock furniture, 2¼-inch, Wilkes' spindles, 15/ to 18/ per dozen sets; sham ditto, 8/ to 9/ per dozen sets; **Norfolk latches**, common, best, 55 to 65% common **Suffolk latches**, 70 to 72½%; best Suffolk latches, 45 to 55%; tinned struck **ladle bowls**, 4-inch, 15/6 to 16/6; 4½-inch, 18/6 to 20/; 5-inch, 23/ to 25/ per gross net.

**Netting**, wire, galvanised, 57½% to 60½%, delivered **Cast nails**, **lath**, 10/6 to 11/6 per cwt.; cast wall nails 9/6 to 12/ per cwt.; cast headed bills, ⅜ by 8 ounce, 15 to 16/; fine round cast bills, ⅜-inch, 14/ to 16/; strong round cast bills, ⅜-inch, 13/ to 16/; cast slate pegs, 13 to 17/; cast garden loops, 15/ to 17/ per cwt., all at works. **Patent wrought nails**, 32½ to 37½% per thousand and 27½% those sold as weighty by the cwt.; **patent machine-made horse nails**, 25 to 30%; **cut-nails**, clasp, clout or rose nails, 3 inch and upwards, 11/ to 12/6 per cwt.; cut lath nails, 1 inch and upwards, 14/ to 15/6; cut flooring brads, 2½ inch and upwards, 11/3 to 12/9; fine cut tacks, ½ inch, 35/ to 38/ per cwt.; ¾ inch 31/6; 1 inch, 27/6 to 28/6 per cwt.; fine cut joiners' brads, or strong, 1½ inch, 16/ to 18/; 2 inch, 15/ to 17/6; 2½ inch, 15/ to 17/; 3 inch, 14/ to 15/6 per cwt.; cut shoe bills, strong, or 12 W.G., 13/6 to 15/6 per cwt.; middle, or 14 W.G., 13/10 15/; fine, or 15 W.G., 15/6 to 16/6; fine cut tacks, per packet, 75 to 80%; fine cut brads, per packet, 62½ to 65%; **wrought nails**, long count, 15 to 20%; wrought nails, May, 1826 list, to 32½ 37½%; **wrought Bromsgrove nails**, March, 1878, list, 15 to 17½%; best countersunk clout nails 1, inch, 35/6 to 37/6; 2 inch, 26/ to 27/6; 2½ inch, 22/ to 25/6; best best countersunk and **half-countersunk horse nails**, fine best; Swedish charcoal iron, 17/6 to 19/6% list prices; wrought rose or deckhead **spikes**, 4 inch, 15/6 16/, 5 inch, 15/6 to 16/; 6 inch, 15/ to 16/; fine, /6 to 1/ per cwt. extra; galvanised, 7/ to 8/ per cwt. extra; **wrought rose nails** for India, 2 inch, 10 lb., 21/6 to 22/6; 2½ inch, 13 lb., 20/ to 21/; 3 inch, 20 lb., 19/ to 19/6; **malleable nails**, coffin nails, black, 35 to 40%; white lacquered and gilt, 25 to 30%; sacking; moulders' nails and chaplets, 1½ inch to 3 inch, 28/ to 20/; bright nuggets, 28/6 to 20/; tile pegs, 15/ to 16/ per cwt.; bright nails, 4/ to 5/ extra; tinned nails, 12/ to 13/ extra; galvanised nails, 10/ to 12/ extra; **nuts**, square forged, untapped, ¼ inch, /10 to 1/ per gross; ½ inch, 25/ to 26/ per cwt.; ¾ inch, 23/ to 24/ per cwt.; square forged nuts, tapped, ¼ inch, 1/2 to 1/4 per gross; ½ inch, 30/ to 32/; ¾ inch, 27/ to 29/; forged **hexagon**, untapped, ¼ inch, 1/10 to 2/; ½ inch, 32/ to 34/; ¾ inch, 27/ to 29/; forged hexagon, tapped, ¼ inch, 2/2 to 2/4; ½ inch, 30/ to 42/; ¾ inch, 31/ to 33/; machine-made nuts, square untapped, ½ inch, 20/ to 22/; ¾ inch 18/ to 20/; 1 inch, 18/ to 20/; square tapped, ½ inch, 25/ to 26/; ¾ inch, 23/ to 25/; 1 inch, 24/ to 26/; machine-made hexagon nuts, untapped, ½ inch, 21/ to 30/; ¾ inch, 22/ to 24/; 1 inch, 22/ to 24/; hexagon tapped, ½ inch, 35/ to 36/; ¾ inch, 30/ to 32/; 1 inch, 28/ to 30/.

**Oddwork**, tinned and black, 15 to 20%, list; **Paris pointes**, best English, 15/6 to 16/; foreign, 18/ to 20/; **planes**, 25 to 30%; iron **axle pulleys**, 1¾ inch, 12/6 to 18/; brass face axle pulleys, 28/ to 40/ per gross; B. F. and wheel, 48/ to 60/ per gross; brass escutcheon **pins**, ⅝ inch to 16 W. G., 1/ to 1/2 per lb.; bright gimp pins, ½ to 19 W. G., /6 to /8 per lb.; black, /7 to /9; brass 1/6 to 1/8 per lb. Japanned cut **gimp pins**, ½ inch, /7 to /8 per lb.; tinned, /8 to /9 per lb.; cut clog or coffin pins, japanned, ⅝ inch, /5 to /6; tinned, /7 to /8; brass pin pointes, 1/4 to 1/6; **plate locks**, fine 40 to 50%; strong, 30 to 35%; Lancashire plate locks, 25 to 30%; pewter measures, 20 to 25%.

**Riddles**, 30 to 35%; **Rivets**, iron boot rivets, /3½ to /4 per lb. patent machine-made Rivets, 30 to 35%; wrought tinmen's Rivets, 50 to 55%; round or panhead boiler Rivets, ½ inch, 23/ to 24/; ⅝ inch, 18/ to 19/; ¾ inch, 17/ to 18/; ⅞ inch, 16/ to 17/. Delivered in London or Liverpool; machine-made wire Rivets, ¾ inch, 14/6 to 15/6 per cwt. **Rakes**, light garden Rakes 50 to 60%; light solid end Rakes, 47½ to 50%; bolstered teeth garden Rakes, 50%; solid end bolstered teeth garden Rakes, 40 to 45%.

**Spades and Shovels**, common, 52½/ to 55%; second, 35 to 40%; best 30 to 35%; best strong country Shovels; 25 to 30%; best hammered Spades and Shovels, 5 to 10%; **Ship Scrapers**, black steel blades, 45 to 50%; bright, 42½ to 47½%; cast-steel black, 42½ to 47½%; bright, 37½ to 42½%; best cast-steel black, 35 to 40%; bright, 30 to 35%; iron **Wood Screws**, 65%; brass wood Screws, 60 to 62½%; copper, 35 to 45%; Stove Screws, 50 to 57½%; dowel Screws, 60 to 65%; brass headlock Screws, 40 to 47%; gilt, silvered and plated head Screws, 40 to 45%; jute **Sash cord**, 52½ to 57½%; flax Sash-cord, 25 to 30%; best flax, 5 to 10%; super flax, 7½ to 12½%; extra super flax Sash-cord, 5 to 10%; patent steel ribbon **Sash-line**, 25 to 35%; copper **Sash-chain**, 52½ to 57½%; zinc Sash-chain, 47½ to 52½%; iron prepared, 40 to 45%; copper Sash-cord, 15 to 20%. **Sad irons**, common, 10/6 to 12 per cwt.; best japanned, 14/6 to 16/6; best best japanned, 18/ to 20/ per cwt.; **Shoe heels**, York, No. 1, 3/5 to 3/8; No. 2, 4/ to 4/3; No. 3, 8/ to 8/9 per gross net; Dundee hot turned, 5/9 to 6/3; bright-edge imperial or solid Scotch, 9/6 to 10/; bright York 61 B, 8/ to 8/6; bright solid, 6/6 to 7/; toe plates, 9/6 to 10/ per gross. **Stair rods**, turned ends, 75 to 80%; solid fancy ends, 60 to 65%; cased tube, 30 to 35%; patent solid ornamental, 35 to 40%. **Sofa Springs**, coppered, 8 by 6 inches, 25/ to 27/ per gross; 9 by 7 in, 21/6 to 23/6; 7 by 7 inches, 17/6 to 19/6 per gross; galvanised **Waterloo Scoops and hods**, 17/6 per doz.; japanned Waterloo scoops and hods, 16 inch, 15/ to 16/; japanned scoops and hods, light, 16 inch, 15 to 16/ per doz.; **Shutter bars**, common spring, broad and double, 75 to 77½%; Scotch iron drop, 77½ to 80%; brass drop, 70 to 72½%; brass drop and catch, 67½ to 70%; registered brass spring box shutter bars, 52½ to 67½%; double-handed brass spring box, 57½ to 65%; **Saddlers' tools**, 5 to 10%; **Stocks and Dies** for smiths' use, 35 to 40%; ditto for engineers, 10 to 20%; **Steel toys**, 10 to 30%.

**Traps**, bow spring, sham Dorset and real Dorset rabbit traps, 45 to 65%, list prices; common traps, 4 inch, 5/6 to 8/ per doz. net; run traps, 2½ inch, 4/ to 8/6 per doz.; bird traps, 3/9 to 4/ per doz.; wolf and other double flat spring, common bridge, 1/; axle bridge, 1/4 per lb., 40 to 45%; hawk or pole traps, 54 to 60%; wrought mole traps, japanned, 2/6 to 3/9; galvanised, 3/9 to 4/9. **Tin plates**, I C, 30/ to 32/. **Tinmen's machines** and tools, 5%; brass **Bell Tube**, ⅜ inch and upwards, 1/ to 1/1 per lb.; copper bell Tube, 1/2 to 1/4 per lb.; zinc bell Tube, 45 to 50% list; **Patent cased Tube**, 45 to 50%; cut to lengths, 40 to 45%; burnished and lacquered brass tube, 30 to 35%; polished and lacquered twisted brass tube, 30 to 35%; patent taper iron tube, 30 to 35%; patent cased taper iron tube, 30 to 35%; parallel iron brased tube, 30 to 35%; twisted iron parallel tube, 30 to 35%; patent cased twisted iron parallel tube, 30 to 35%; iron **Gas Tubes**, 60 to 62½%; fittings, 62½ to 65%; iron **Water Tubes**, 50 to 52½%; fittings, 52½ to 55%; iron **Steam Tubes**, 45 to 47½%; fittings, 47½ to 52½%; galvanised iron gas Tubes, 45 to 47½%; fittings, 47½ to 50%; lap-welded **Boiler Tubes**, 47½ to 50%, delivered in London, Liverpool or Glasgow; table catches, 36 to 40%; ditto, improved brass follow, 20 to 25%; wrought japanned **Tea kettles**, 50 to 60%; galvanised **Turnip skips**, 21 inches, light, 25/ to 26/ per doz.

**Vices**, common black, 32 to 34/ per cwt.; common bright, 40/ to 42/ per cwt.; black staples vices, solid box black, 42 to 48/; bright, 41/ to 47/; solid box, black staple, with spherical washer, 40/ to 45/; bright 41/ to 55/.

**Washers**, light iron, 70%; heavy washers, 13 to 16 lb., W.G., 12/6 to 14/ per cwt.; ¼ inch thick, 2/ per cwt. extra; 5-16 inch, 3/; ⅜ inch 4/; shook bright washers, 3/ to 3/6 per cwt. extra; **Wall hooks**, 23/ to 25/ per cwt.; **Washing tubs**, galvansed oval, 22 inch, 19/ to 30/; 24 inch, 34/ to 35/; round, 22 inch, 38/ to 40/; **Water bowls**, hammered, list price, 52½ to 57½%; light seamed 9 inch, 8/ per dozen; light wired 9 inch, stamped, 11/ to 12/; **Wove wire** list price, iron, copper and brass, 45 to 50%; iron **Wire**, bright, 0 to 6, 13/ to 14/ per cwt.; galvanised, 17/ to 18/; fine galvanised iron wire, No. 23, 5/ to 5/3 per stone 14 lb.; annealed tinned wire No. 18, 3/10 to 4/ per stone 14 lb.; cut tinned bottling wire, No. 22, 4/8 to 5/3 per stone 14 lb.; weaving and binding, wire, No. 23, 3/9 to 3/10 per stone 14 lb.; bright or annealed fine wire, 23, 5/4 to 5/6 per stone 14 lb. net; cast steel wire, 0 to 6, /9½ per lb.; 10 to 20%; metallic or horticultural wire, 6 to 14, /5½ to /6½ per lb; No. 15, 5¼ to /6; 16 to 20, /5½ to /6½; in 1 lb. rings, 1½ inch diameter, /½ per lb. extra; prepared bright **fencing Wire**, 0 to 6, 13/6 to 14/ per cwt.; annealed drawn fencing wire, 0 to 6, 10/6 to 11/; annealed drawn galvanised, 0 to 6, 16/6 to 17/. Bright or annealed steel, 0 to 6, round or oval 15/9 to 16/6 per cwt.; black rolled, 1 to 4, 10/6 to 11/6 per cwt.; galvanised rolled, 1 to 4, 13/9 to 14/6 per cwt.

THE PITTSBURGH IRON TRADE OF 1879.—The receipts of all kinds of crude iron and iron ore in Pittsburgh last year, says the *American Manufacturer*, were larger than in any previous year by over 166,000 tons. The figures below show the receipts for the last eight years, the figures for the first seven years having been published in the *Manufacturer* of April 11, 1879:—1872, 496,648 tons; 1873, 538,918; 1874, 631,182; 1875, 410,604; 1876, 479,798; 1877, 552,037; 1878, 676,728; and 1879, 843,251 tons. The following are the various items that make up the total for last year:—Cinder, 18,099 tons; scrap iron, 74,426; blooms, billets, &c., 41,903; pig-iron, 303,030; and iron ore, 405,793 tons. With the exception of cinder all the above items show a large increase as compared with the receipts in 1878. Especially is this true with respect to pig iron and iron ore. Large, however, as were the receipts of ore, they promise to be much greater in the present and future years. Well informed ironmakers say that the local furnaces are now consuming about 1000 tons of ore a day, while the rolling mills require about 400 tons, as "fix" for 1000 puddling furnaces, making a total of 1400 tons, or over 500,000 tons a year. One of the furnaces of the Edgar Thomas Steel Company has just been blown in, the second is about ready to blow, and the third will be put in blast next summer. These will consume about 125,000 tons of ore a year, which added to the above total, makes a grand total of about

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625,000 tons of ore, which is the amount that the Smoky City will probably require each year for a year or two to come. It is noteworthy that one of the railroads which in former years brought little or no ore to the city—the Pittsburgh branch of the Baltimore and Ohio—last year brought nearly 50,000 tons. The larger part of this was foreign ore, but some of it came from Virginia, and hereafter much larger quantities will be brought from that section, as the ore deposits there are now being vigorously developed.

The Geological Survey of the United States.—A great deal of discussion is at present going on among scientific men in the United States about a Bill passed by Congress at the extra session, for the establishment of the geological survey of the Public Domain, by which it would seem that this survey is extended over the whole area of the United States, including the States as well as the western territories. Professor T. B. Dana, so well known as one of the leading geologists of this time, states that this proposed expansion of the field of work under the Director of the Geological Survey is wholly foreign to the views expressed in the report of the committee, to the opinions brought out in the discussion, and that it is, moreover, entirely at variance with the objects set before the committee by the Act of Congress requiring its appointment. This Act required that the members of the committee should "take under consideration the methods and expenses of conducting all surveys of a scientific character under the War or Interior Department and the surveys of the Land Office, and that they should report to Congress as soon thereafter as may be practicable a plan for surveying and mapping the territories of the United States on such a general system as will in their judgment secure the best results at the least possible cost." The new scheme seems scarcely compatible with this, for a survey of the States as well as of the territories would most certainly involve the expenditure of millions. Professor Dana believes that the Constitution has left to the States the making of their own geological surveys and the study of their own economical resources. It will also be remembered that the General Goverement, unlike that of many other countries, has no vested interests in, and no royalties over, mines or quarries. Coming from such a source, this protest, published in the *American Journal for Science* for December last, is a weighty one, and it is supported by the editors of another influential Philadelphian paper, the *American Naturalist*, who remark that while the United States geological surveys were, under Hayden and others, confining their attention to developing a knowledge of the natural resources of the western territories, the results accomplished were excellent, and very much useful information was from time to time published—information of great importance to would-be settlers, and directly assisting in opening up this portion of America. But during the season just ended little or no geological exploration has been carried on in the western territories, and while some small parties were sent to Leadville and the Eureka mines, and to the Comstock lodes and the Californian goldfields, no general geological work has been accomplished. What the American people seem to want is more information about the unsurveyed, often unexplored, lands of the Far West, and it is to be hoped that the survey, even as at present constituted, will see to this, and not spend time or money in going on with work that may either be actually in progress or in prospect in any of the States.

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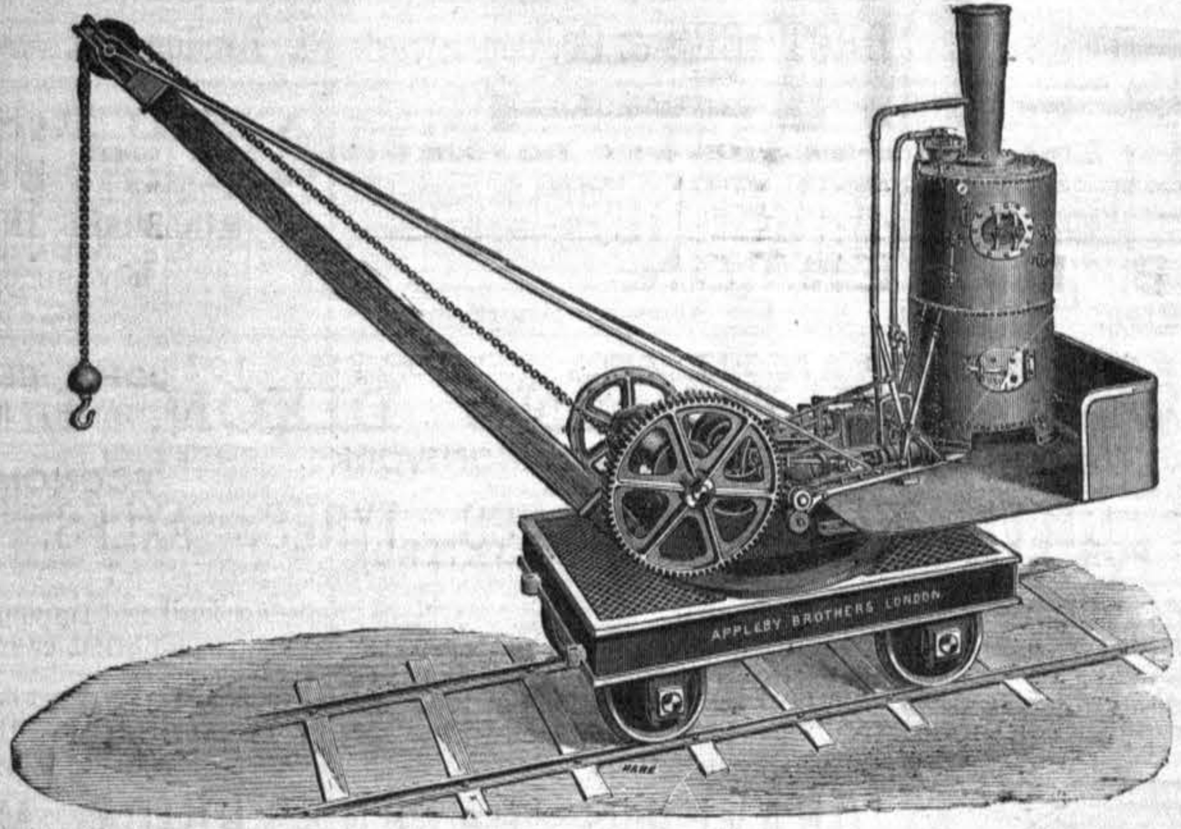
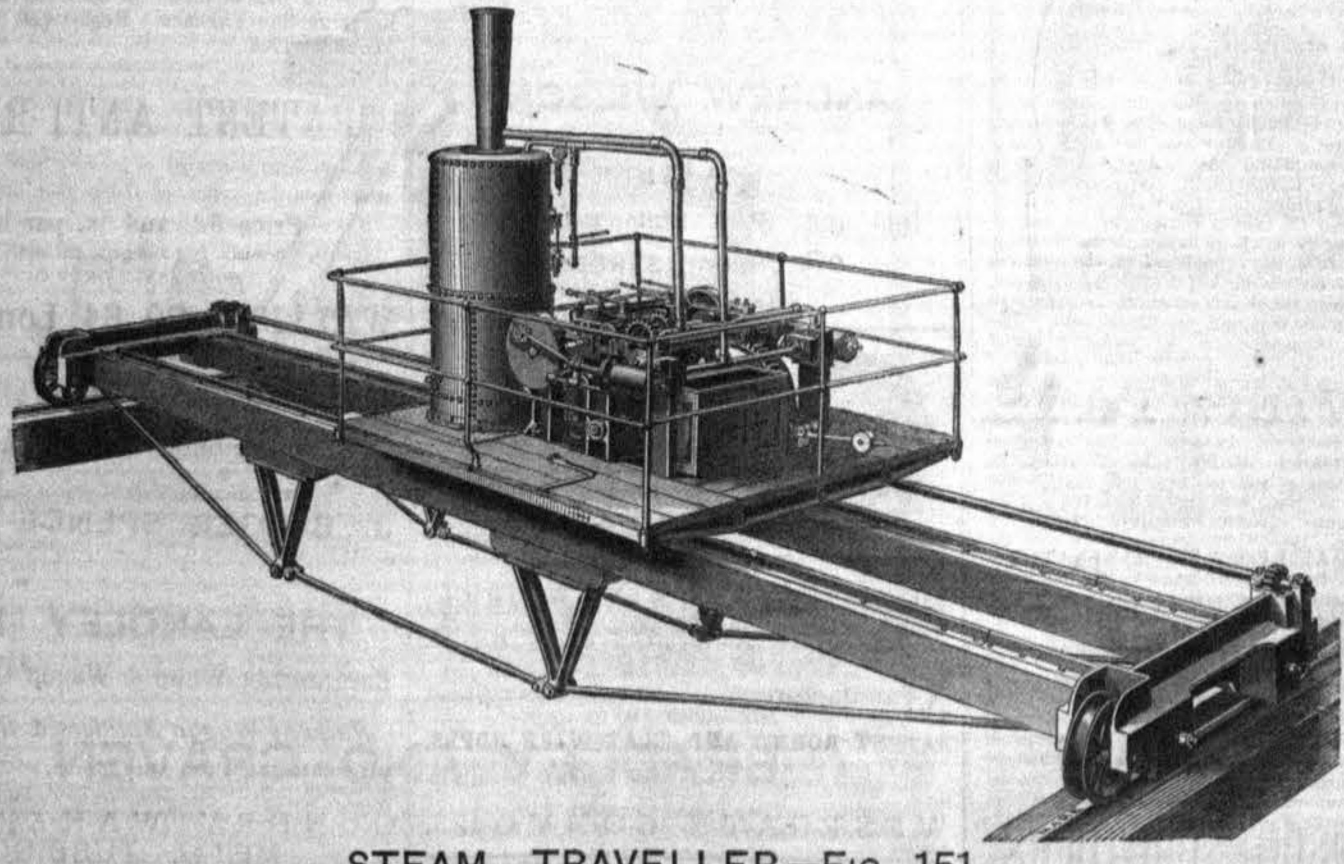


FIVE TONS STEAM CRANE.—FIG. 116.



STEAM TRAVELLER.—FIG. 151.

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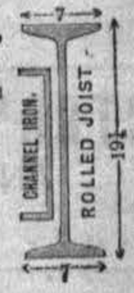

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| 8 × 4 | 3½ × 3½ | 3 × 3 = 10lbs. | 5 × 3 = 13lbs. | 7 × 2 = 14lbs. | 9½ × 3½ = 24lbs. | 12 × 5 = 42lbs. | 5 × 6 | 12 × 3 |
| 6 × 6 | 3 × 3 | 3 × 1½ = 5 ,, | 5 × 4½ = 23 ,, | 7 × 3½ = 20 ,, | 9½ × 4½ = 29 ,, | 12 × 6 = 56 ,, | 4 × 4½ | 9½ × 3½ |
| 6 × 3½ | 2½ × 2½ | 4 × 1½ = 7 ,, | 6 × 2 = 11 ,, | 8 × 4 = 22 ,, | 10 × 4½ = 32 ,, | 14 × 6 = 60 ,, | 5 × 3 | 9¼ × 3½ |
| 5 × 3½ | 2 × 2 | 4 × 3 = 12 ,, | 6 × 3 = 16 ,, | 8 × 5 = 29 ,, | 10 × 5 = 36 ,, | 16 × 6 = 62 ,, | 3 × 3 | 8 × 3½ |
| 4 × 3 | 1½ × 1½ | 5 × 2 = 8 ,, | 6 × 5 = 29 ,, | 8 × 6 = 34 ,, | 10 × 6 = 54 ,, | 18 × 6½ = 82 ,, | 2½ × 2½ | 6 × 2½ |
| 4 × 4 | 1 × 1 | | | | | 19½ × 7 = 100 ,, | 2 × 2 | 4½ × 2½ |
| | | | | | | | 1½ × 1½ | 2½ × 1 |
| | | | | | | | 1 × 1 | |

JOISTS—Lengths, from 6 to 36 ft. PLATES—Width, 6" to 18"; Length, 12 to 30 ft.; Thickness, ¼" to ½".

GOLD MEDAL, PARIS, 1878.

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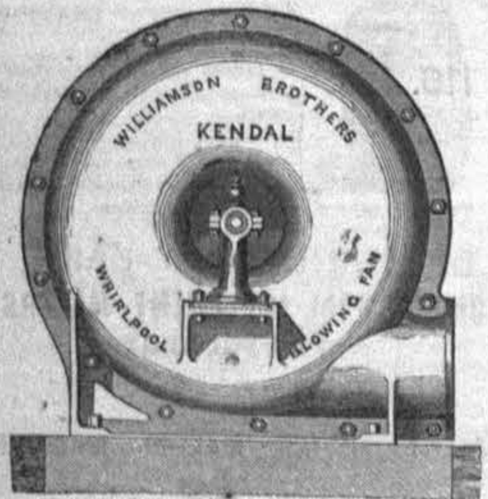

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The best means of utilising water-power.

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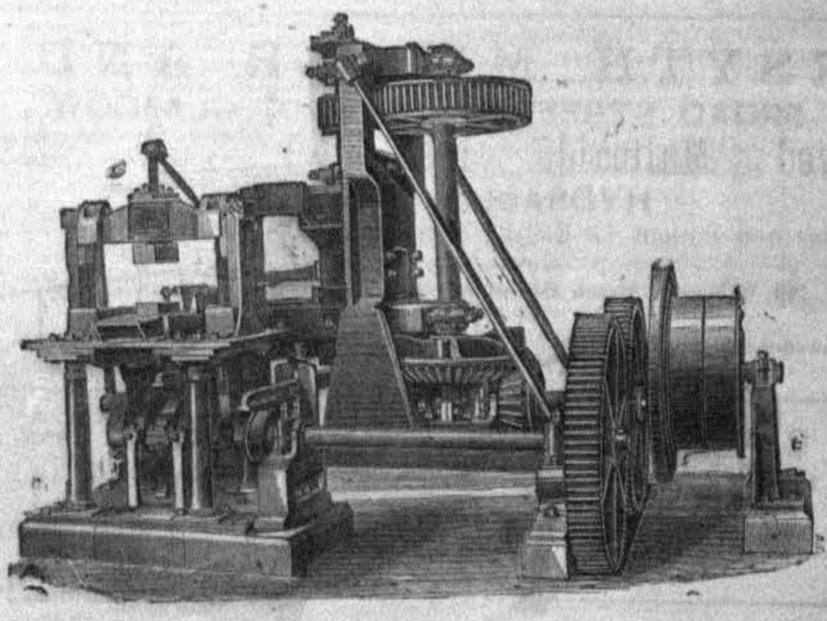

The above Machine, recently introduced, is the result of 30 years' experience in manufacturing Machinery of this class. By its action the clay is first pugged, then moulded under considerable pressure, and on delivery from the mould table the bricks are again powerfully pressed before removal, when they are ready for placing direct in the kiln, thus embracing all the advantages of the semi-dry making, and at the same time the quality produced is that of the best plastic made and pressed brick.

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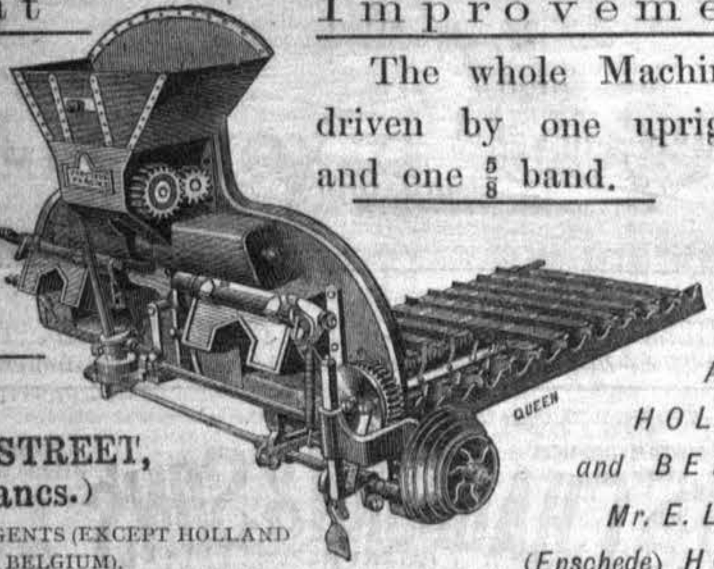

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FROM ONE-HALF TO ONE-FIFTH THE PRICE OF LEATHER.

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Short length for trial supplied at wholesale prices. (No post samples.)

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NEW INJECTOR.

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Great Simplicity,

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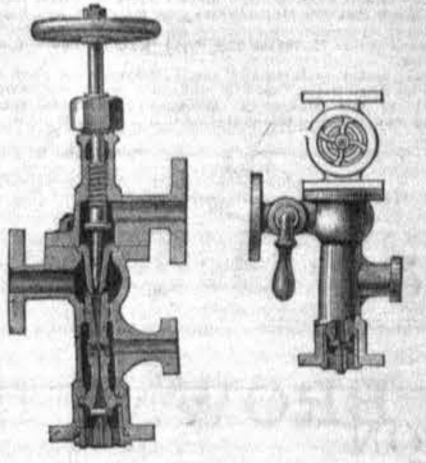

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All kinds of Crude and Manufactured Asbestos kept in Stock.

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Recent improvements have rendered this Gauge extremely sensitive and durable. It is now made to register to 1500 deg. Fahrenheit. It is applied to Ovens, Heating Stoves, Boiler Flues, Heated Air, Hot Liquid Steam, Gases, &c. Testimonials on application.

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TO ENGINEERS.

This Corporation being desirous of receiving TENDERS for the Construction, Delivery and Erection of a FIRST ORDER LANTERN Complete for the Anvil Point Lighthouse, near Swanage, in the County of Dorset, Notice is hereby given that the Drawings may be inspected and Forms of Tender and Specifications obtained on application at the Store Department at this House on any day between the hours of 10 a.m. and 4 p.m.

Tenders sealed and marked outside "Tender for First Order Lantern for Anvil Point," must be addressed to the Secretary and delivered at this House on MONDAY, the 16th February next, and no Tender can be entertained that is not made on the form provided.

The Corporation does not pledge itself to accept the lowest or any Tender.
By Order.
ROBIN ALLEN, Secretary.
Trinity House, London, 29th January, 1880.

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**DECAUVILLE'S PATENT PORTABLE RAILWAY.**
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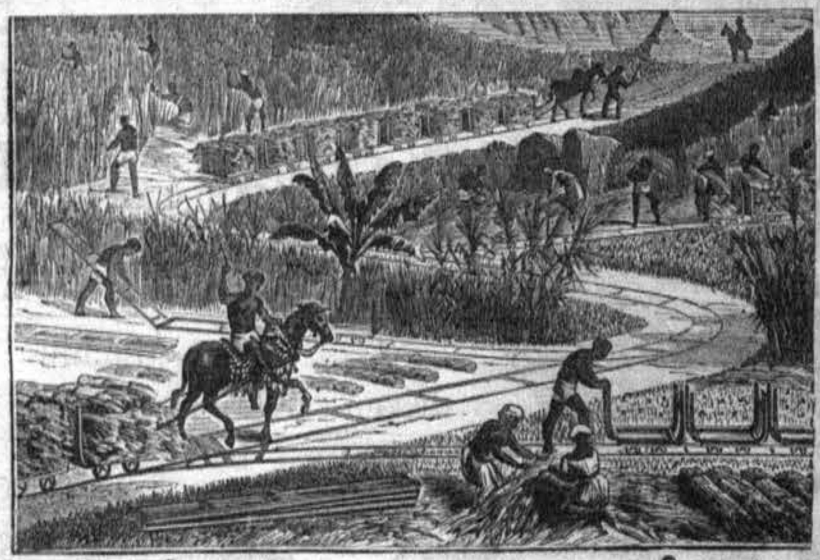

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11, WATERLOO ROAD.
LIVERPOOL,
LONDON:—96, FENCHURCH ST.
GLASGOW: 2, TAYLOR PLACE, GOVAN ROAD. | NEWCASTLE: 40, BLENHEIM STREET.

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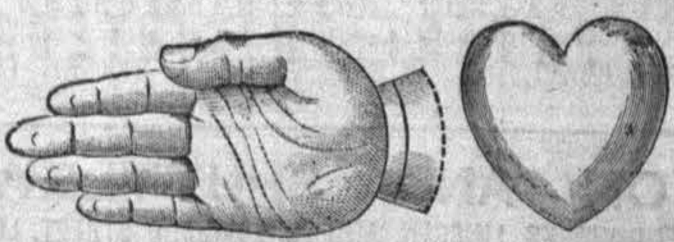
CORPORATE MARK.



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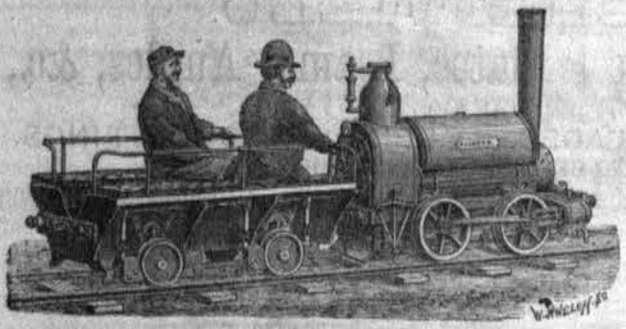

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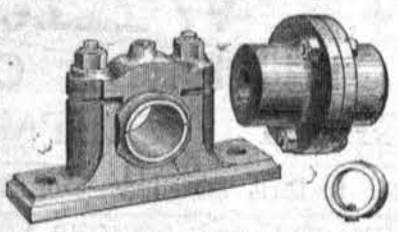
| Do. Plain do.... | 5 | 6 | 7 | 8 | 10 | 13 | 16 | 20 | 25 | 30 | 38 | 45 | 55 | 80 | 90 |



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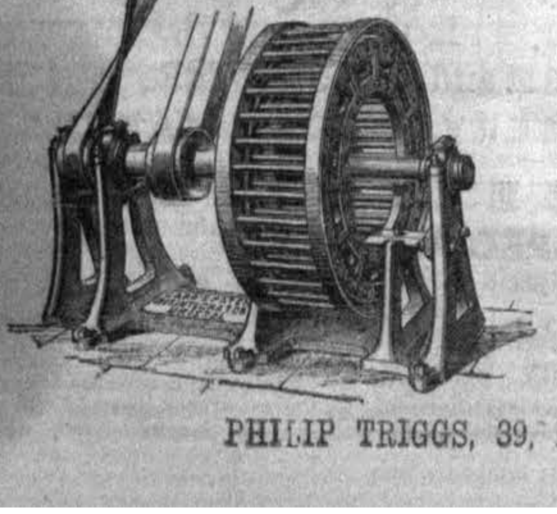

**This Machine effectually pulverises by the combined influences of percussion and of centrifugal force, Iron, Zinc, and other Ores, Asphalte, Artificial Manures, Phosphates, Fire Clay and many other substances. It is also largely in use for the pulverisation of coal for the manufacture of Coke, Patent Fuel, &c.; and is very effective for mixing Sugar.**

These Machines are capable of reducing to a fine granular powder from 50 to 200 tons per day (according to size) of any unfibrous material. Machines made to order from 18 inches diameter, to suit special requirements of purchasers; these small machines being specially adapted to the requirements of Chemical Manufacturers for Mixing and other purposes.

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ENDLESS BANDS for Portable Engines.

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## BLAKE'S SELF-ACTING HYDRAULIC RAMS

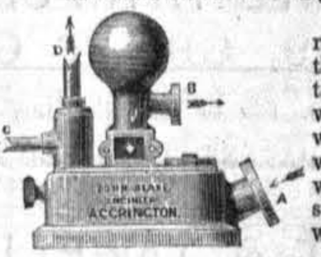
*For Raising Water for the Supply of Villages, Irrigation, Railway Stations, Mansions, Fountains, Farms.*

No cost for Motive Power, which is obtained from the Stream of Water passing through the Rams.

**WILL FORCE TO A HEIGHT OF 1500 FEET.**

Made in sizes to raise from 300 to 100,000 gallons per day.

**NO OILING OR PACKING REQUIRED.**



**This Ram will raise a part of the same water that works it, or will raise pure water from a well whilst it is worked by a stream of impure water.**

TESTIMONIALS.

FROM CAPTAIN TOWNSHEND, WINKHAM, FEB. 10, 1877.

"In answer to your enquiry, I am glad to say the Hydraulic Ram you sent me in November, 1875, is working exceedingly well, and gives no trouble. It will work when quite immersed, as it has been several times during the floods this winter, forcing up water through a delivery pipe 900 yards long at the rate of 80,000 gallons per day although you only promised 50,000."

FROM W. SCARTH, ESQ., AGENT TO HIS GRACE THE DUKE OF CLEVELAND.

"Raby Castle, Darlington, July 16th, 1878.

"The Hydraulic Ram you supplied to His Grace the Duke of Cleveland in 1875 is a complete success. It worked for more than two years without once stopping, and throws more water than promised."

FROM JOHN TAYLOR, ESQ., THE ROCKS, BATH, AUG. 22, 1878.

"The Self-Acting Hydraulic Ram you fixed here in March of last year continues to work well. It has only the same quantity of water and fall to work it as the waterwheel and pump which I used previously to force to a height of 294 feet, and yet the ram sends up more than double the quantity of water that the wheel did to the same height."

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JOSEPH GILLOTT'S
STEEL PENS.

Sold by all Dealers throughout the World.

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HORSFALL'S PATENT COMBINED BOLT, RIVET, & NUT FORGING MACHINES

MAKES BOLTS
WITH
SQUARE, HEXAGON OR CHEESE HEADS,
AND WITH
SQUARE OR ROUND NECKS.
WHICH DO NOT REQUIRE
DRESSING OR FINISHING BY HAND.

OVER 60 OF THESE MACHINES HAVE BEEN SUPPLIED TO BOLT AND NUT MANUFACTURERS, ENGINEERS, &c.

MADE IN THREE SIZES, TO MAKE FROM THREE-EIGHT INCH TO ONE AND A HALF INCHES DIAMETER, ANY LENGTH.

MAKES NUTS,
SQUARE OR HEXAGON,
WITHOUT
ANY LOSS IN PUNCHING,
AND DOES NOT REQUIRE
DRESSING OR FINISHING BY HAND.

TO SEE MACHINES WORKING,
APPLY TO
SAMUEL MARSDEN AND SON,
SOLE OWNERS OF PATENT,
MANCHESTER SCREW BOLT WORKS,
MANCHESTER.

NO SKILLED LABOUR REQUIRED TO WORK THESE MACHINES.

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As supplied to the Admiralty, and to stand Lloyd's and Board of Trade Tests.
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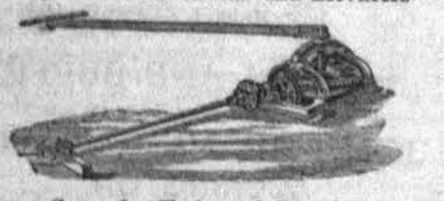

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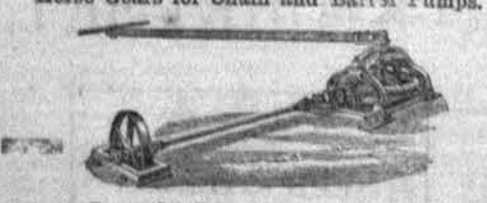

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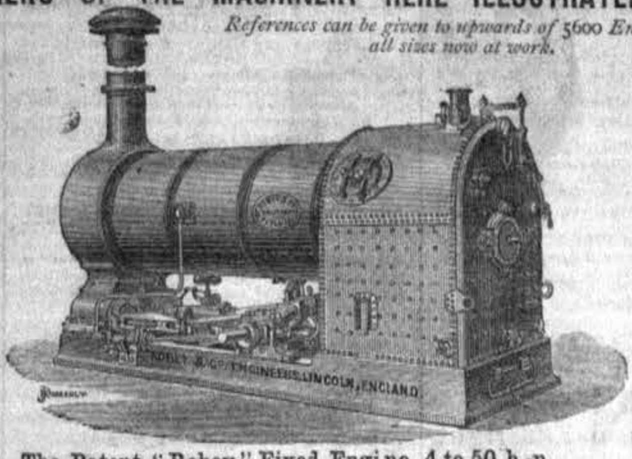

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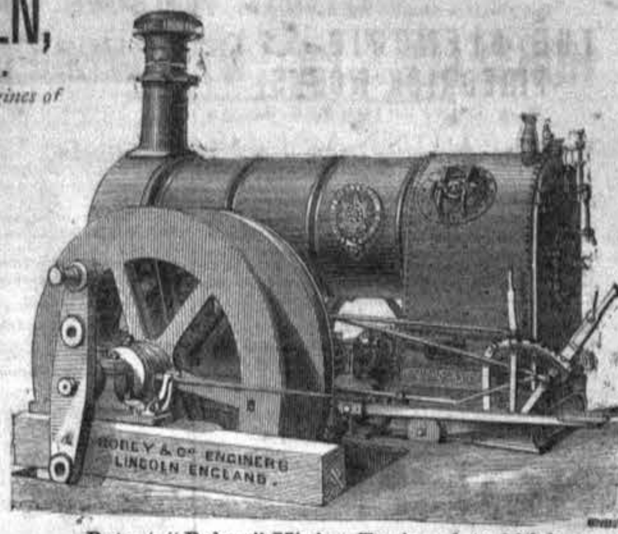

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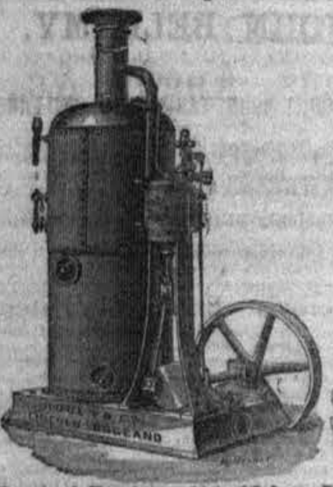

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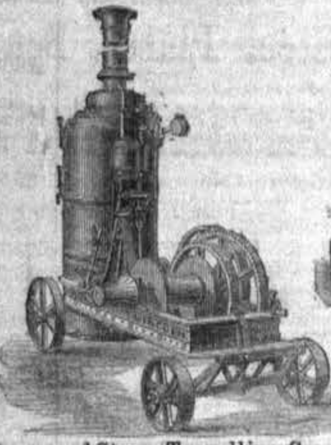

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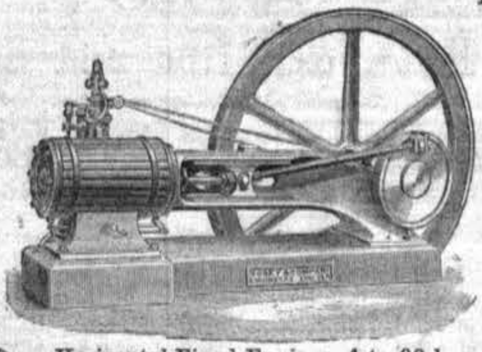

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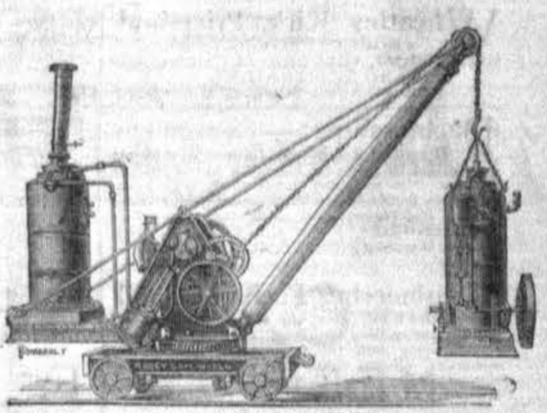

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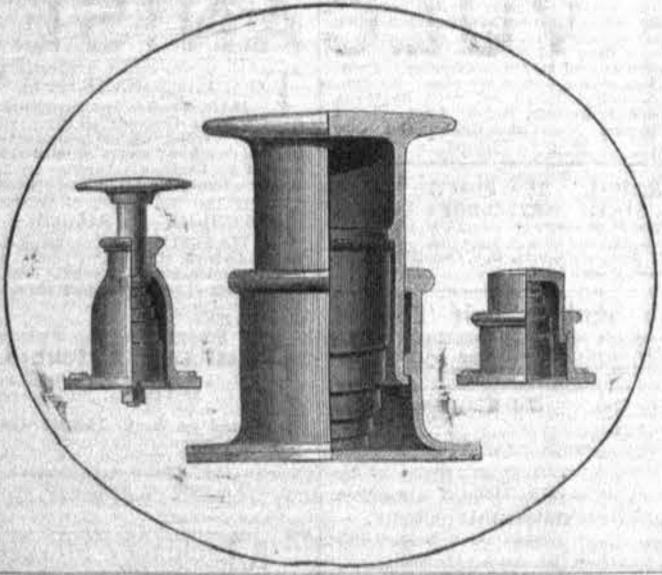

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OF THE HIGHEST QUALITY, WITH GRINDING LINE. A LARGE STOCK ALWAYS READY FOR DELIVERY.
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The Secretary of State for WAR is prepared to receive Tenders for the Purchase of the following MACHINES, now lying at the Gun Wharf, Portsmouth:—

- One Lathe, old, incomplete, and in pieces.
- One Machine, Vent-cutting.
- One Machine, Venting, B. L. Guns.
- One Machine, Vent-drilling.
- Four Machines, Shell-boring.
- One Machine, Horizontal-boring.
- One Machine, large fly, Planing.
- One Machine, Percussion Cap.
- One Machine, Truck-boring.
- One Machine, Steam Saw Frame.
- One Machine, Bullet.
- One Machine, Lead Squirting.

Tenders must be made upon the proper Form, which may be obtained on application to the Commissary-General of Ordnance, at the Gun Wharf, Portsmouth, where the Machines may be seen, and all necessary information obtained.

The Tenders are to be delivered at the War Office, Pall Mall, S.W., by 12 o'clock noon, on WEDNESDAY, the 18th day of February, 1880, addressed to the Director of Army Contracts, and marked on the outside, "Tender for the Purchase of Machines."

The Machines may be viewed between the hours of 10 and 4 o'clock every day (Saturday afternoons and Sundays excepted) prior to the above-named date.

EVAN COLVILLE NEPEAN,
Director of Army Contracts.
Army Contract Department,
War Office, Pall Mall, S.W.
2nd February, 1880.

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IMPORTANT TO CAPITALISTS, BLAST FURNACE PROPRIETORS, AND BESSEMER STEEL PROPRIETORS.

VALUABLE HEMATITE IRON ORE MINES IN THE FURNESS DISTRICT

To be Sold by Auction, by Mr. JAMES ROBINSON, at the County Hotel, Ulverston, Lancashire, on THURSDAY, the 4th day of March, 1880, at 3.30 p.m.

All that valuable Hematite Iron Ore Mine, situate in the parish of Dalton-in-Furness, in the county of Lancashire, commonly called the DALTON MINES, the property of the Dalton Mining Company (Messrs. Denners Brothers and Co., Ulverston), with the Mineral Rights, and power to work and get Iron Ore, over an area of 118 acres, 0 rood, 17 perches, stat. measure, more or less, situate in the heart of the Furness Ore District, and within a quarter of a mile of the Dalton Station on the Furness Railway.

Satisfactory reasons given for disposal.

For further particulars see detailed advertisements in the *Engineer* and IRON newspapers; and conditions of sale, plans of royalty, and schedule of plant and tools, at 1s. each, may be obtained from the Auctioneer, at his office at Dalton-in-Furness, or from S. Hart-Jackson, Solicitor, 49, Market Street, Ulverston.

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SALE OF OLD BRASS AND GUN METAL AT THE ROYAL ARSENAL, WOOLWICH.

The Secretary of State for War will be prepared to receive Tenders for the purchase of OLD BRASS AND GUN METAL, now lying at the Royal Arsenal, Woolwich, where the Metal may be viewed, and forms of Tender and all information obtained on application to the Commissary-General of Ordnance, between the hours of 10 and 4 o'clock on any day (Sundays and Saturday afternoons excepted) prior to the date for receipt of Tenders.

A deposit of five pounds will be required on each form of Tender issued.

The Tenders are to be delivered at the War Office, Pall Mall, S.W., by 12 o'clock noon on FRIDAY, the 20th day of February, 1880, addressed to the Director of Army Contracts, and marked on the outside "Tender for the Purchase of Old Metal."

EVAN COLVILLE NEPEAN,
Director of Army Contracts.
Army Contract Department,
War Office, Pall Mall, S.W.
9th February, 1880.

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The Minerals, and the right to get and work the same, in and under 75 Acres of Land or thereabouts, situate within a ring fence at Frizington, in the parish of Arlecdon, in the county of Cumberland, and commonly called and known as Hogget or Howgate, in the midst of the Cumberland Hematite Iron Ore District.

The Minerals on this estate have never been let, and the royalty is untried, but from its proximity to the valuable mines in the district there is every probability of its being worked to profit.

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# IRON AND STEEL.

*ESTABLISHED IN THE YEAR 1823 AS "THE MECHANICS' MAGAZINE."*

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A Paper on "The Utilisation of Coal Slack in the Manufacture of Coke for Smelting," by Mr. G. M. Ward, will be read and discussed.
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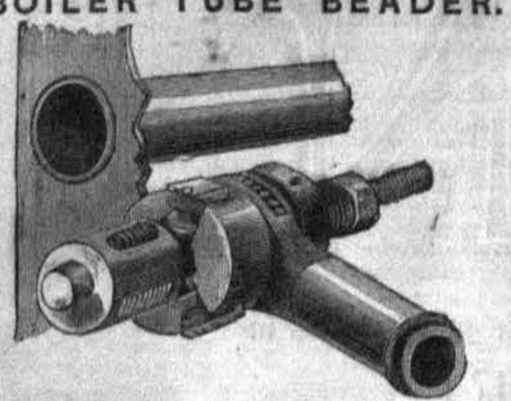

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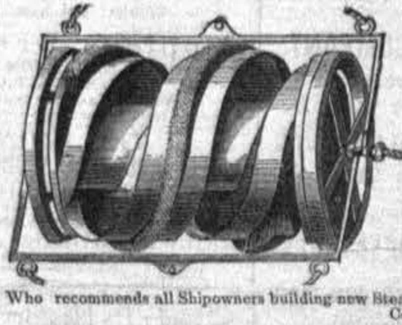

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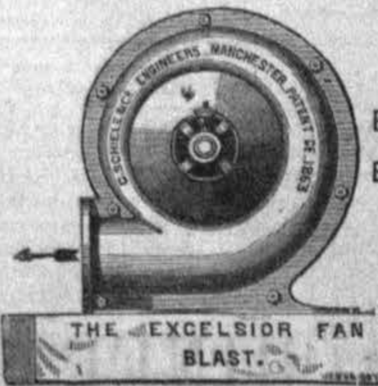

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FIG. 3. HANDLING BY CRANE.

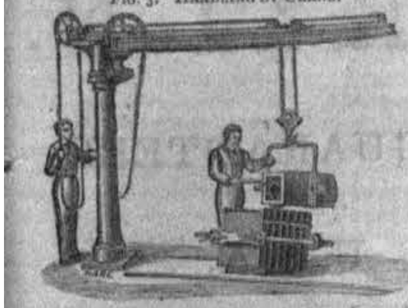


Figure of 130 lbs. and above, to be handled with the aid of a crane and one man.

These Furnaces can be placed in any desired position in a Foundry or shop; brought to wherever required; and very easily handled.

They yield the following "practical" results, attainable **only** by their **Special Oscillating Capacity**, thus obviating the necessity of taking the Crucible out of the Furnace. Hence **Economy in Fuel, in Hand Labour, in Crucibles**, and in **Time**. No waste whatever; and Immunity from Accidents.

Cheap Crucibles can be used instead of Plumbago, thus giving an advantage of 300 per cent. in Crucibles alone.

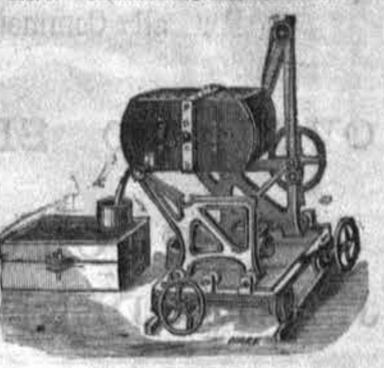
The following results have been obtained by using these Furnaces:—

| BRASS. | |
|---|---|
| No. of Castings ... ... ... ... | 10 |
| Time ... ... ... ... ... ... | 8 hours. |
| Quantity Cast ... ... ... ... | 5·23 cwt. |
| Coke used ... ... ... ... ... | 22 per cent. |
| Capacity of Furnace ... ... ... | 90 lbs. |

| BRONZE. | |
|---|---|
| No. of Castings ... ... ... ... | 12 |
| Time ... ... ... ... ... ... | 9 hours. |
| Quantity Cast ... ... ... ... | 12 cwt. |
| Coke used ... ... ... ... ... | 22 per cent. |
| Capacity of Furnace ... ... ... | 110 lbs. |

**N.B.—The economy in working these Furnaces becomes more apparent with each successive casting, owing to the Patent Oscillating Arrangement. This is one of the special advantages of the system.**

FIG. 2. FURNACE ON MOVEABLE CARRIAGE.



Arrangement for running the furnace where no crane is available and the weight is considerable.

## ILLUSTRATIONS SHOWING MODE OF WORKING THE FURNACE, &c.

## TESTIMONIALS.

From MIRRLEES, TATE and WATSON, Glasgow. Glasgow, Nov. 7th, 1879.

In reply to your inquiry of 4th inst., we are glad to say that the two Brass Furnaces supplied to us by M. Piat, are working satisfactorily, and we have no objections to your referring intending purchasers to us.

(Signed) MIRRLEES, TATE and WATSON.

To M. PIAT.

We have pleasure in sending you the results of our experience of the Portable and Oscillating Furnace you supplied us with for the casting of steel.

First Casting:—Furnace lit at 7.30 a.m.; blast put on, 8.20; charge, 25 kilos.; coke, 50 kilos.; cast at 10.5.

Second casting:—Blast put on at 10.35, with 25 kilos. of steel, which was cast at 11.25. To obtain an ingot of 45 kilos., they filled the crucible twice. All was ready for casting, which took place at 1.30, using 38 kilos. of coke.

Third casting:—Blast at 1.15; charge, 20 kilos.; following charges, 15 kilos.; casting at 4; coke used, 25 kilos. in all.

Resume:—In three castings, results—105 kilos. of steel (in ingots), consuming 113 kilos of coke.

The steel was completely liquid, and the temperature of the furnace more than sufficient for steel casting. With our own furnaces we consume 2½ of coke for each kilo. of steel. We authorise you to make use of the present as you deem fit.

(Signed) SEKUTOWIEZ ET HUBER, Bronze and Steel Foundry.

To M. PIAT. From M. LHOST, Rue des Boulets. Paris, 27th May, 1879.

The 40 kilos. Patent Furnace you furnished me with works well, and can be easily handled. With the aid of the moveable carriage I cast (in small pieces) bronze with the greatest facility, the consumption of coke being 9 to 10 kilos. per cast, lasting about 35 minutes. I intend to employ these furnaces on a larger scale in the new premises I am now preparing. (Signed) LHOST.

To M. PIAT, Paris.

From M. MERCIER, Chief Engineer of Waagner's Establishment, in Vienna.

I am in receipt of your favour of the 18th December, and hasten to inform you that the trials made by M. Waagner, of your patent system, fully satisfy me, and give very good results.

(Signed) GUSTAVE MERCIER.

The following recent Testimonial shows the special salient points of PIAT'S system, obtained after a SERIES OF CONTINUOUS CASTINGS, and affords the opportunity of forming a correct judgment of its advantages and merits:—

Results of working a 220 lbs. PIAT'S PATENT PORTABLE AND OSCILLATING FURNACE, with natural draught and using clay or plumbago crucibles indifferently, at the Works of Crozet and Co., Loire, France, on January 12th, 1880.

| Number. | Furnace lit. | | Time of Casting. | | Duration of charge. | | Weight of Bronze charged. | | | Coke consumed. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | h. | m. | h. | m. | h. | m. | cwt. | qrs. | lbs. | cwt. | qrs. | lbs. |
| 1 | 6 | 0 | 8 | 20 | 2 | 20 | 1 | 3 | 4 | 0 | 2 | 18 |
| 2 | 8 | 25 | 10 | 0 | 1 | 35 | 1 | 3 | 4 | 0 | 1 | 14 |
| 3 | 10 | 5 | 11 | 5 | 1 | 0 | 1 | 3 | 7 | 0 | 1 | 18 |
| 4 | 11 | 10 | 12 | 0 | 0 | 50 | 1 | 3 | 4 | 0 | 0 | 26 |
| 5 | 12 | 5 | 1 | 10 | 1 | 5 | 1 | 2 | 12 | 0 | 0 | 26 |
| 6 | 1 | 15 | 2 | 15 | 1 | 0 | 1 | 3 | 4 | 0 | 0 | 24 |
| 7 | 2 | 40 | 3 | 15 | 0 | 35 | 1 | 2 | 14 | 0 | 1 | 0 |
| 8 | 3 | 20 | 3 | 50 | 0 | 30 | 0 | 1 | 27 | 0 | 0 | 11 |
| | | | | | 9 | 15 | 12 | 2 | 20 | 2 | 1 | 25 |

Thus yielding 153½ lbs. of bronze per hour, at a cost of 30 lbs. of coke—say 19½ per cent. (coke) and 39 min. per 100 lbs.

To M. PIAT, Paris. LE CHAMBON FEUGEROLLES (LOIRE), January 13th, 1880.

We have the pleasure of handing you a statement of the working of your Furnace of 100 kilos. (220 lbs.) under the direction of M. Charlier. The results obtained are highly satisfactory, and we have pleasure in recording them.

(Signed) CROZET and Co.

The economy in working these furnaces becomes more apparent with each successive casting, as above demonstrated, owing to the patent oscillating arrangement.

## OPINIONS OF THE PRESS.

(From *Engineering*, of Nov. 21, 1879),—PIAT'S OSCILLATING FURNACE.

"A new form of portable crucible furnace has lately been introduced with great success in France, by M. Piat, of Paris. The advantages claimed are a marked economy of fuel and labour, a greater durability of the crucibles, and increased rapidity of melting. As we have already said, this form of furnace is being largely introduced in France, and the experience obtained with it appears to bear out the various claims made for it."

From *Iron and Coal Trade Review* of May 30, 1879.

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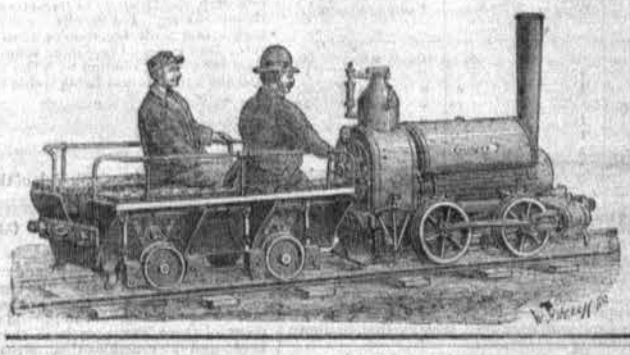

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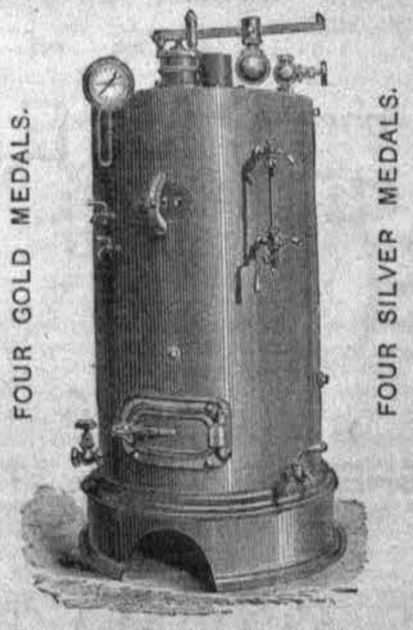

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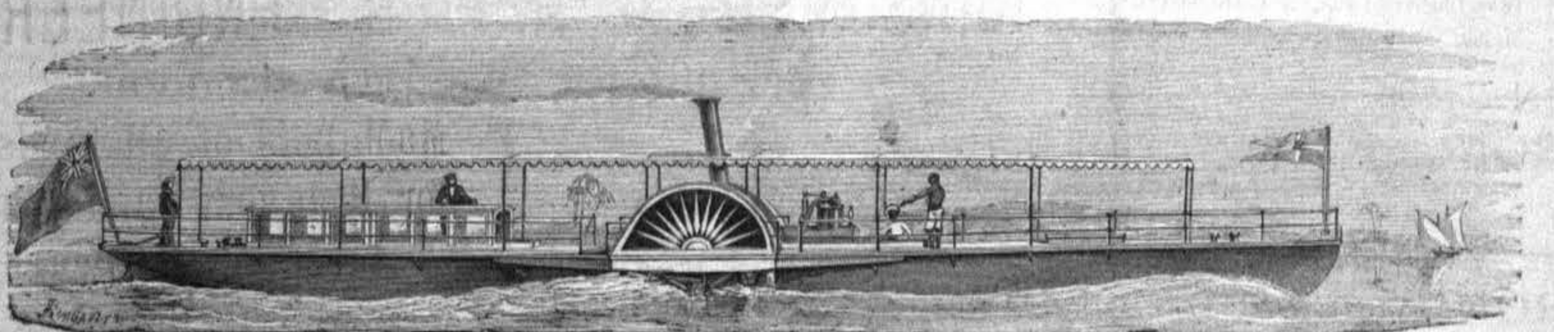

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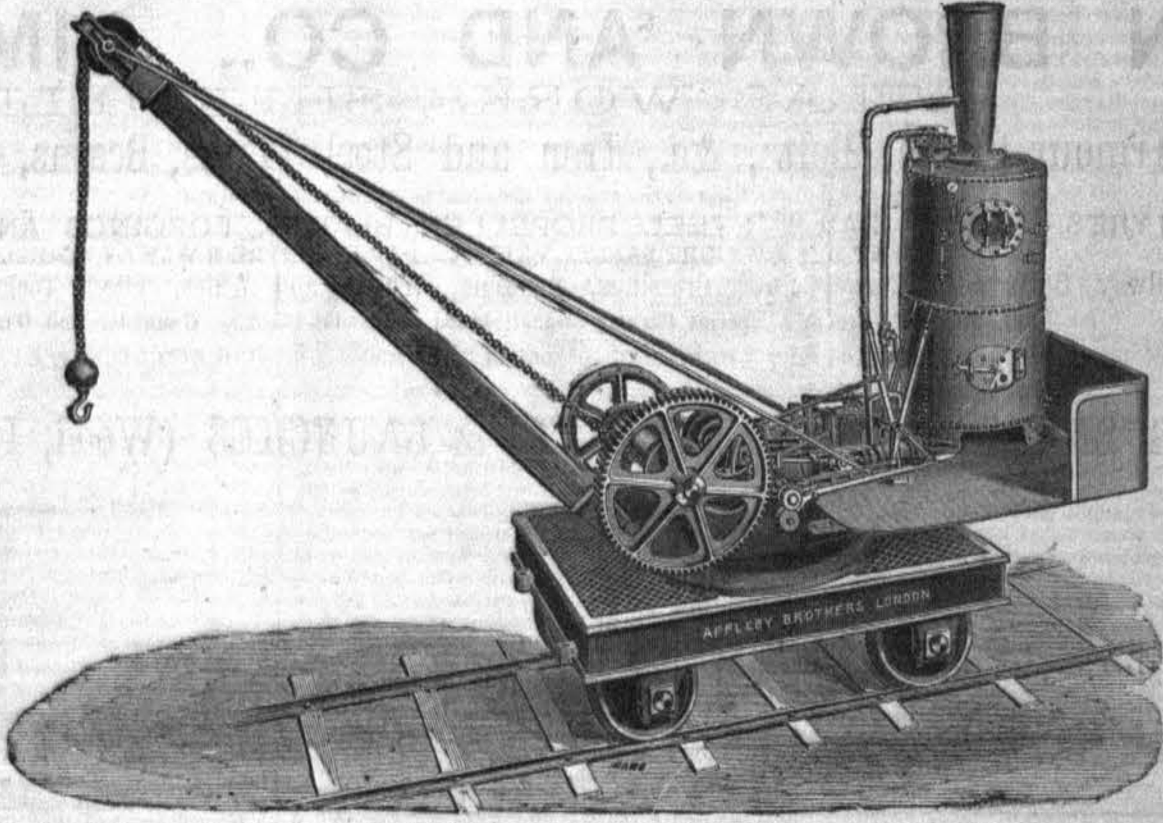
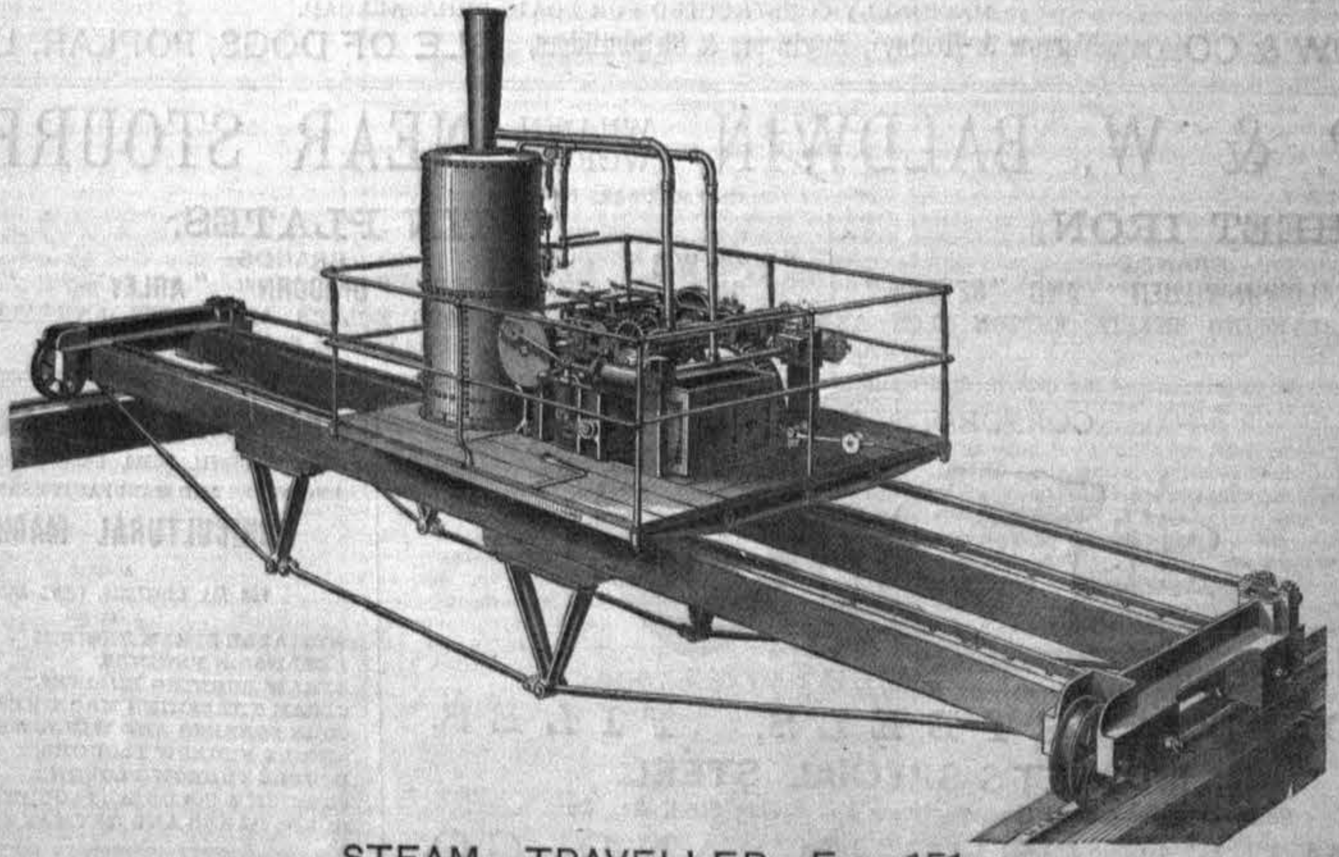


FIVE TONS STEAM CRANE.—Fig. 116.



STEAM TRAVELLER.—Fig. 151.

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*LONDON, FRIDAY, FEBRUARY* 20, 1880.

## COMPOUND ARMOUR.

THE battle of guns *versus* armour has been fought—and well fought, too—for many years past. At one time it has been the guns that have had the best of it, whilst at another the plates have baffled the guns. No sooner has this latter condition obtained than the guns have been increased in size and power, until at last they would seem to have been left masters of the situation. This being the case, another effort to turn the tables upon the guns has been made, this time not by increasing the thickness of the iron plates, which had already about reached the limits of safety as regards the ship, nor by making them of steel, which is not adapted to resist every kind of artillery fire, but by effecting a compromise, and using both these metals in conjunction. The precise value of steel, as a material for armour plates, was established by the artillery experiments which were carried out in the autumn of 1876 at Spezzia. There both wrought iron and steel plates were tried by both light and heavy artillery. The result showed that whilst 10-inch projectiles penetrated from 10 inches to 13 inches into the solid iron plates, the steel plates, though not penetrated, were so starred and split by the racking to which they had been subjected that they threatened to fall to pieces. But whilst the steel plates were unable to withstand a continuous fire from even comparatively light ordnance, they nevertheless resisted the punching energy of the 100-ton gun, though shivering under blows which easily penetrated the iron armour. The inference drawn from these and other circumstances was that steel was well calculated to enable a vessel to bear a single blow of a projectile from a gun of superior power to its armour; while, on the other hand, such plating must be expected to crumble under the continuous fire of guns which could not easily injure wrought-iron armour of the same thickness.

The question arising upon this was how the special qualities both of the iron and the steel might best be turned to advantage in keeping out the projectiles. In other words, the manufacturers of armour plates had to discover the means of producing plates which should be proof against both the punching and the racking effects of artillery fire. For the successful solution of this problem the country is indebted to our two great armour-plate makers, Messrs. John Brown and Co., of Sheffield, under their chairman's—Mr. Ellis—patent, and Messrs. Cammell and Co., also of Sheffield, under Mr. Alexander Wilson's patent. The way in which they solved the question was to effect a perfect union of the two metals and to produce a compound plate, that is, a plate having a steel face and an iron backing. Here the steel does its work in preventing penetration by causing the shot to break up on impact, whilst the iron performs its part in preventing the destruction of the steel by reason of its greater tenacity and ductility. We need hardly say that the two metals had previously been successfully welded together for use in railway practice, but the conditions in artillery practice were so widely different that plates simply welded together were found to separate very soon under fire in the early experiments with compound plates. The method by which these plates are now produced by the firms we have mentioned consists in pouring the liquid steel upon the heated iron plate, the details of the process, however, differing in each case. In this process the temperature of the molten steel being in excess of the welding heat of the iron, the surface of the heated iron plate becomes partially fused by the liquid steel, and thus a complete union or weld between the two metals is obtained. In this case the weld is not confined to a simple line marking the difference between the steel and the iron, as in ordinary welds, but a third metal or semi-steel is formed between the two, varying in thickness from ½ inch to 3-16 inch, by the carbon of the steel running into the iron. Through the formation of this zone of anomalous steel the two metals are joined together inseparably; or, in other words, the steel has gradually run into the fibrous iron and the iron into the steel. Experiments have been made to ascertain the relative strength of the weld thus produced, and on every occasion the iron only has been torn asunder, while the weld itself remained undisturbed.

It is unnecessary to particularise either the varieties of plates that were tested, or the tests to which they were submitted during the years 1878-9 by the Government before they finally decided upon the adoption of the compound system, as they have been reported by us from time to time. The experience thus gained led the constructive department of the Admiralty to direct that the turrets of the *Inflexible* should be plated with compound armour, which, as a matter of fact, is now in course of being done. The testing of the plates for this vessel, in conjunction with the results of the previous experiments, so satisfied the Admiralty as to the superiority of steel-faced plates over every other description of armour, that they have finally adopted it as a means of defence for our future ships of war. Orders have accordingly been issued for the turrets of the *Agamemnon* and her sister-ship, the *Ajax*, as well as that of the *Hotspur* ram, to be plated on the new system, which is further to be extended to the sides of other vessels in course of construction—namely, the *Colossus*, the *Majestic* and the *Conqueror*. In like manner, some vessels now in course of construction by Messrs. Samuda Brothers for the Argentine Government will be similarly clad, whilst the same description of protection is also to be fitted to portions of the *Polyphemus* torpedo-ram. Besides the superior resistance afforded by the compound plates, they present another advantage—namely, lesser weight than those of iron, consequent upon lesser thickness. These two important facts, taken in conjunction, undoubtedly point to the compound system of armour as the most appropriate protection yet devised for the ships of the future. That the invention of this system has been the means of placing defence once more on an equality with attack in naval warfare has been amply demonstrated, and until some new feature in gunnery be developed we may fairly say that the guns have been silenced.

## OUR TRADE SUMMARY.

ALL branches of the iron trade continue in a satisfactory condition, and in several of them there is a visible improvement. As regards pig-iron, prices are strengthening, and leading to increased exertions on the part of makers to augment their output. If there is any diminution in the quantity changing hands, it is easily accounted for by the extent to which the ironmasters are sold forward. And this improvement in crude iron appears to be extending more and more to all departments of the metal industries. There has been an unusual amount of fluctuation in the price of Glasgow warrants during the week, partly owing to the varying nature of the reports from the United States; but the information received from many quarters leads us to believe that the Americans will require more of our iron than was generally anticipated a few weeks ago. The closing prices for warrants at Glasgow on Wednesday ranged from 68s. 3d. to 68s. 10½d. The manufactured trade continues active, and the prospects of the shipbuilding interest are still brightening. Ironfounders and engineers, however, as usual, complain of slackness. Prices for pig were higher at Middlesborough on Tuesday than on the previous market day by from two to three shillings a ton. Forge iron is still exceptionally high, No. 3 being quoted at 64s., and the works continue as busy as their capacity will admit of. The plate mills are unable to supply material sufficient for the demands of shipbuilders. In the hematite districts of the north-west there is little to add to the tale of prosperity. Many, if not most, of the producers are sold so far in advance as to be prevented from taking further orders, although these are being pressed upon them both from the Continent and America. Steel makers continue very busy, but to a considerable extent on early and consequently comparatively unremunerative contracts. Still, from the great demand, prices are strengthening to some extent. Favourable reports also come from the Durham district, where additional furnaces are being prepared for putting in blast. In the smaller centres of Lincolnshire, Derbyshire and Notts there is no diminution in the iron output, and the collateral branches of the trade, where they exist, are generally in a flourishing condition. From Manchester the tone of the pig-iron market is reported equally firm, but local makers, being sold well forward, do not seem anxious for additional orders. The finished-iron trade is brisk and rates firm; and the long delayed revival of the cotton industries is giving a better tone to machine and other trades depending upon it. Almost all the branches in South Yorkshire are in a thriving state, with increased firmness in quotations, and the steel manufacture appears to be specially active. The competition of steel is affecting the best iron trade of West Yorkshire considerably, a tendency which is not likely to diminish but the demand for railway materials appears to be increasing, as are also inquiries for boiler plates. The depression of the agricultural interest has materially interfered with the implement trade. The Birmingham hardware trades are in an unsatisfactory condition, although there is an improved demand for certain specialties from the Cape and South America; but the home trade remains in a dull condition. From South Staffordshire on the other hand the accounts are more encouraging. The lock trade appears to be brisk and there is a better inquiry for ships' chandlery and similar goods on foreign account. There is no change to report in coal or coke; in some descriptions of the former there seems to be a falling off, both in demand and prices.

## HISTORY OF MODERN INVENTION IN THE MANUFACTURE OF IRON.

By W. Mattieu Williams, F.R.A.S., F.C.S.

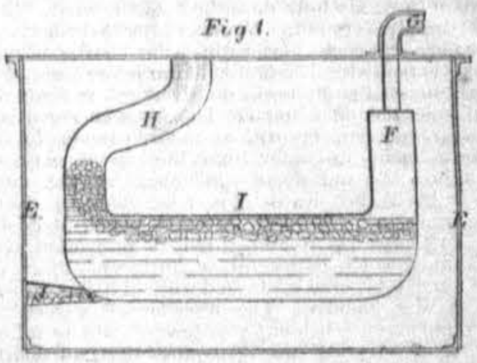
(*Continued from page* 22.)

### The Bessemer Process.—No. 9.

THE first part of No. 630, March 15, 1856, in which the blowing process is applied to existing furnaces, has been already described, with the exception of one supplementary device—viz., that of leaving in the hearth of the refinery furnace, after each charge has been drawn off, a considerable quantity of rich oxide produced in the previous process, so that when a fresh charge of fluid iron is run in from the blast-furnace, this fluid oxide will float upon it, and prevent much loss of heat from the upper surface of the metal. The metallic oxide will also assist in the decarbonisation of the crude metal. With this covering of oxide, it is preferred to dispense with the use of any fuel as a covering to the metal, because the combustion of such fuel is not necessary or beneficial.

Besides applying the under-blast to the molten metal of ordinary furnaces in the manner described, a further claim is made for specially-constructed furnaces, to be used "for the process of decarbonising and refinement of the iron, without the use of additional fuel for that purpose." It consists of "a box or chamber of brick, firestone, or iron, lined with loam or other slow conductor of heat. One form of this refining chamber is shown below, fig. 1, where E is the outer casing of iron, lined with firebrick, F H the chamber, and J the tapping hole, stopped with loam.

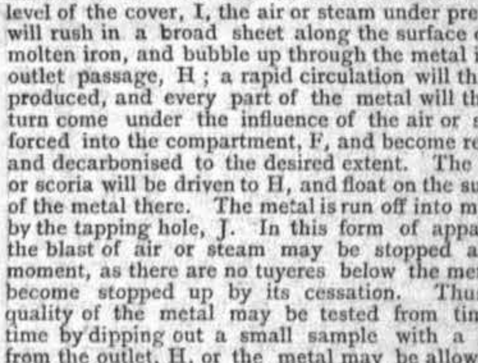
Fig. 1.



The fluid metal is run into this chamber until it rises a few inches above the roof or cover, I; the blast is then let into the compartment, F, at sufficient pressure to depress the level of the metal in F and raise it in H. As soon as the metal sinks to the level of the cover, I, the air or steam under pressure will rush in a broad sheet along the surface of the molten iron, and bubble up through the metal in the outlet passage, H; a rapid circulation will thus be produced, and every part of the metal will thus in turn come under the influence of the air or steam forced into the compartment, F, and become refined and decarbonised to the desired extent. The slags or scoria will be driven to H, and float on the surface of the metal there. The metal is run off into moulds by the tapping hole, J. In this form of apparatus the blast of air or steam may be stopped at any moment, as there are no tuyeres below the metal to become stopped up by its cessation. Thus the quality of the metal may be tested from time to time by dipping out a small sample with a ladle from the outlet, H, or the metal may be allowed to remain for a short time in the chamber in order to cool a little, and thus form a sounder ingot or casting.

Fig. 2. is a modification of the above devised for the purpose of introducing a perforated screen or bridge shown at K. The object of this screen is to prevent the too easy passage of the air and effect a more complete division of the current and its better diffusion throughout the metal.

Fig. 2



The air, after passing through the perforations, and partly—as shown in the figure—below the bridge, K, is again arrested at the roof, M, where it collects until the metal is displaced sufficiently to allow the air or steam to force its way beneath the bridge, N, and rise up and escape through the outlet passage, O. In this form of outlet passage the air or steam has a tendency to escape upwards in contact with the brickwork, instead of passing upwards through the body of the metal. To prevent this the furnace is modified, as shown in fig. 3, where the bridge, P, projects at the lower part, so as to throw off the air or steam and cause it to rise through the fluid metal.

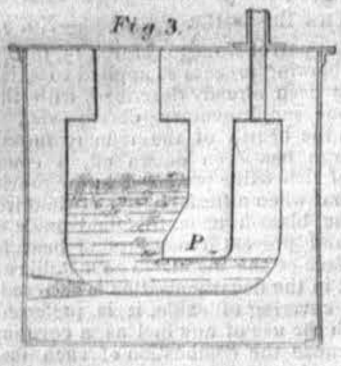


Fig 3.

The specification does not state whether this is to be used with the perforations, and they are not shown, but it is described as a modification of fig. 2. I presume that it was intended to be used either as represented, or with holes through P, as may be found desirable. Mr. Bessemer adds that "many other modifications of this apparatus may be made and used with more or less advantage, the main object being to cause currents of air or steam to be forced through and in contact with molten iron without the use of tuyeres or nozzles situated below the surface of the fluid metal, and thus enable the process to be stopped and resumed when required." Two of these are fully described and figured. Both are simply crucible chambers or hearths with chimney-like necks, down which the charge of fluid metal is poured. The first is blown by a single blast pipe, directed at an angle of about 45° towards the surface of the fluid metal. The blast is urged at a pressure of ten, twenty, or more pounds to the square inch, in order that the metal may be ploughed up and deeply indented by the force of the blast and the fluid iron be made to circulate rapidly. The side of the hearth opposite the blast-pipe has an arched roof or projection over it, against which the metal, when thus ploughed up and circulated, may be dashed without being thrown out of the chamber. The other form is a chamber with upper sides, leaning over towards the neck like the top of a bottle; two blast-pipes descend nearly perpendicularly from this sloping overhang, and conduct a blast against the surface with sufficient force to "penetrate the mass of metal and scatter it in splashes about the interior of the apparatus, and bring it in contact with the scoria or slag floating on the surface of the mass."

To those who only regard the present practice of the Bessemer process, these devices must appear like steppings backward from the converter figured on page 707 of the last volume of **Iron**, and described in the specification of February 12th, 1856. A little explanation of the difficulties with which the inventor was so bravely struggling at the period of these specifications will render the objects of the above-described devices intelligible. Mr. Bessemer proposed to make steel of varying hardness, or soft iron, according to the amount of blowing and consequent oxidation to which he subjected the crude iron. There was no spectroscope then by means of which the operator could see (or imagine that he saw) the decline and vanishing of the carbon combustion, nor had the use of the spiegeleisen been invented. Thus, the time of stopping the blow in order to obtain the desired degree of decarburising was not easily ,determined, in fact, was not determinable otherwise than by taking out trial samples as the oxidation proceeded. To take such samples from the converter at present used, or that shown on page 707 (vol. xiv.), involved a turning over and stopping of the blast, and another turning to recommence, which would very troublesome and endanger solidification. Hence the above-described devices for enabling the workman momentarily and easily to "discontinue the process from time to time, and test the quality of the metal by dipping out a small sample with a ladle." If the air will bubble through the metal as properly as shown in the above figures, these simple forms of furnace are well adapted for experimental work upon such problems as dephosphorising or desulphurising in connection with the Bessemer process, as they could be constructed with comparatively little cost. I suspect, however, that they would not work so smoothly as pictured, but that the blast would burst under the barrier in bubbles of such magnitude as to present too little surface for effective action.

Besides these devices for blowing the melted iron with air or steam, a further claim is made for forcing on or into such fluid metal carburetted gases, or introducing therein fluid or solid carbonaceous substances, in sufficient quantity to combine with any oxide that may exist in or interfere with the malleability of the metal. For this purpose an air-pump or blast-engine connected with a gasometer containing carburetted hydrogen gas is used, and this gas is forced through the same tuyeres or passages as are otherwise used for the passage of air or steam; or in lieu of this a pole or mass of wood is forced down below the surface of the fluid metal "until the carbonaceous gases which are emitted therefrom have united with or removed any excess of oxygen from the metal," or any suitable carbonaceous matter, such as charcoal, anthracite coal, or a carbonate of iron that is rich in carbon is put into the crucible or chamber, or in lieu of this charcoal is put into a cylinder or other shaped vessel, and when in a state of combustion air or steam, or a mixture of both, is passed through the heated carbon and from thence into the melted metal. Mr. Bessemer adds that "here I would observe that the vapours thus forced into the metal may be made to have a carbonising or decarbonising effect, according to the properties in which the constituents of the different gaseous vapours predominate, and whereby I am enabled to produce malleable iron or steel as may be desired." This passage indicates the struggle that was then proceeding with the difficulty I have above described. Besides the above devices for blowing and the injection of carbonaceous matter, the addition of "scales of iron or other iron oxides or iron ore" is claimed for the purpose of assisting the decarbonisation process by their reduction, and also adding to the quantity of metal.

The third part of this invention is an interesting anticipation of a device which long remained in abeyance, but has now become generally adopted. Up to the time of my leaving Sheffield in 1870 the common method of casting Bessemer ingots was to swing the ladle over a row of moulds and run the metal into them from above by simply pouring from the ladle plug into the open mouth of the mould. At about the time named, and a little later, an improvement on this was adopted whereby the solidity of the castings was much improved. It consisted in pouring into the bottom of the mould instead of the top, the fluid metal rising from below as the moulds filled. This device constitutes a portion of the third part of the present invention. In this third part it is first proposed to "avoid the unsoundness sometimes caused by pouring the metal into a separate mould" by making the refining chamber of such size and shape that it shall itself constitute an ingot mould, and leaving the metal therein to gradually solidify after the blowing has been completed. When this is inconvenient an ingot mould is constructed "having a runner or gate communicating with the bottom of the mould and extending upwards to the top of it so that the mould is filled from its lower end, the metal rising upwards until it is filled." It is curious that this simple and valuable device should have been practically disused for about fifteen years, and then revived so lately.

As a further means of preventing cellular structure due to imprisoned air bubbles, Mr. Bessemer proposes to close the mould with an air-tight cover, through which passes a tube connected with a vessel from which the air has been exhausted, On opening the cork in this tube a partial vacuum will be formed in the mould, and the fluid metal in communication with the lower part will rise into this vacuous space "without producing that admixture of air which results from pouring in the metal from above, while the lessened pressure of the air, above the surface of the metal, will assist in the disengagement of any gaseous matter contained therein." This vacuum process has not been similarly adopted. It appears to me a far more hopeful method of removing gas-bubbles than that of compression, which must diminish their bulk and increase their tension rather than improve them. Compression may have other beneficial effects, but can scarcely be of any service in this respect.

## LAWRENCE'S MILK CALORIFIER AND REFRIGERATOR.

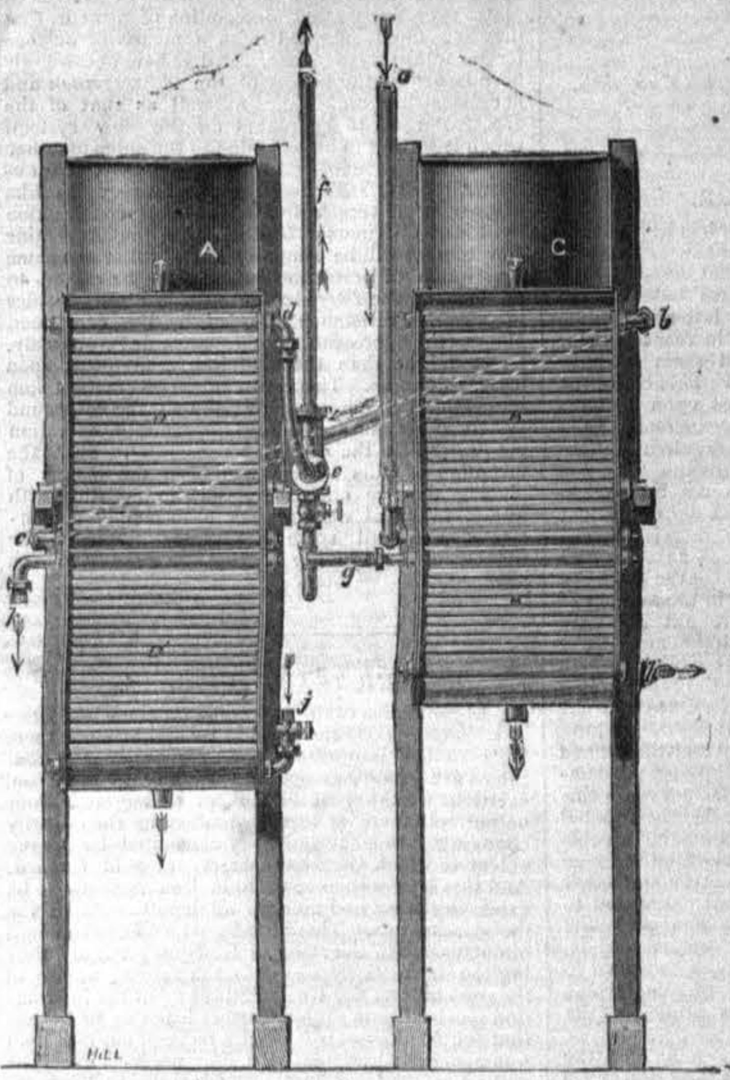


Fig. 1.

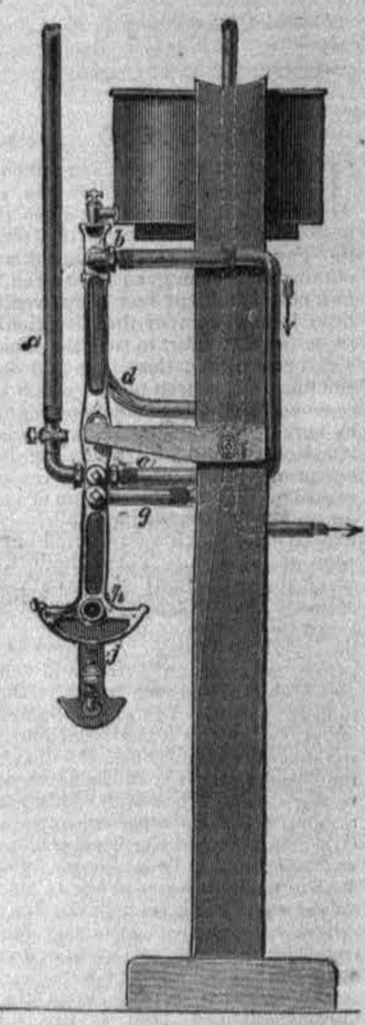


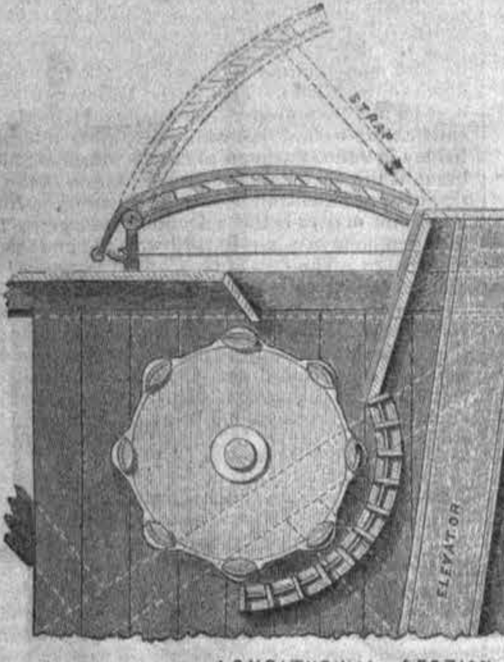
Fig. 2.

## MILK CALORIFIER AND REFRIGERATOR.

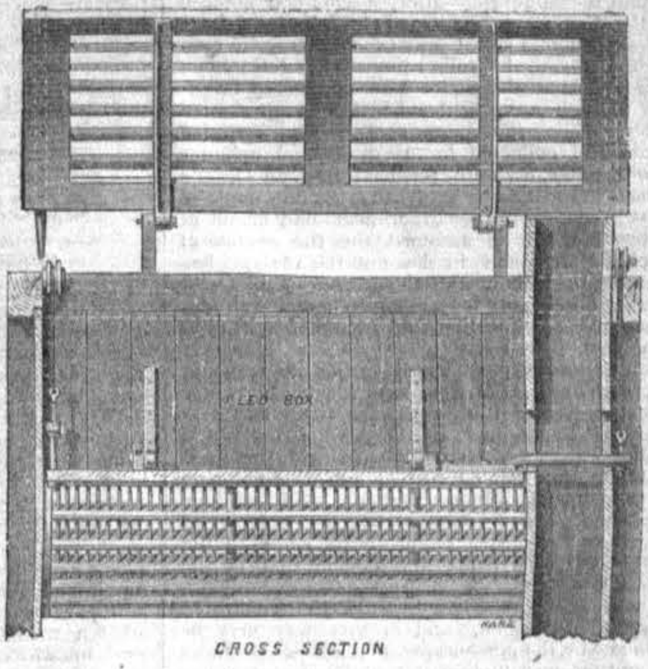
In order to keep milk sweet for consumption in large towns, especially if it has to travel long distances by rail, or for the manufacture of butter and cheese, it is necessary to destroy the contained germs, which would otherwise speedily bring about its corruption; this is most effectually performed by raising it to a high temperature. It is also necessary to render the conditions unfavourable for the absorption by the milk of germs from the atmosphere, which is best accomplished by reducing the temperature. And further, it is advisable to get rid of the gases which the milk has retained from the animal organism, and which have a tendency to taint it, an elimination most readily effected by aëration. Messrs. Lawrence and Co., of 22, St. Mary Axe, London, have now applied their capillary system of refrigeration to the combined scalding, cooling and aëration of milk in one simple apparatus, shown in front view at fig. 1, and side view at fig. 2, of the accompanying engravings. The milk contained in the reservoir, C, runs over the corrugated surface, B, heated by water coming from a tank by the pipe, *a*, and passing inside to *b*. The milk gradually takes up the heat as the water parts with it, and then flows over the lower portion, B¹, heated inside by steam

# SELF-ACTING DRUM-GUARD.

MANUFACTURED BY MESSRS. RICHARD GARRETT AND SONS, LEISTON.



LONGITUDINAL SECTION



CROSS SECTION

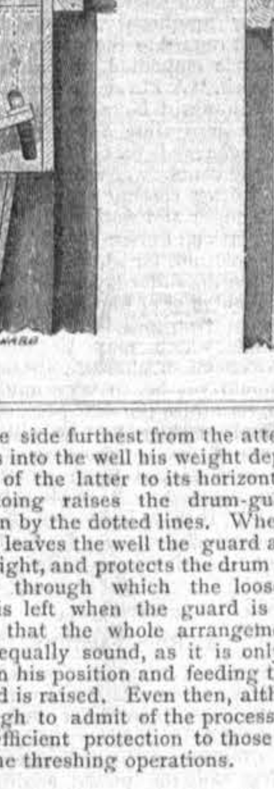
which enters by the pipe, *g*, and makes its exit at *h*. In this way, any degree of temperature desired may be given to the milk, which is then either poured into the reservoir, A, or into a large appliance raised by a pump or injector. It is allowed to flow over the portion D, where it is cooled by the water, already reduced in temperature by heating the milk in the calorifier, and then passing from *b* to *c*. This water, rising inside the refrigerator and increasing in heat as the milk outside becomes cooled, passes out by the pipe, *d*, and is forced by the injector, *e*, through the pipe, *f*, into the water tank, where the small amount of heat it has lost by radiation is restored by a jet of steam, to be again used in the calorifier. The milk, on arriving at the bottom of the refrigerator, D, has been lowered in temperature to within 2° Fahrenheit of that of the water inside, when it passes over the lower section, $D^1$, being reduced to a still lower temperature by a stream of iced water entering at *j* and passing out at *k*. At the same time, the fact of the milk being exposed in a thin film over a large surface brings all the molecules so thoroughly into contact with the atmosphere that the gases above named are eliminated. Thus the three operations necessary to the preservation of milk go on rapidly and almost simultaneously, with a very slight consumption of fuel, owing to the regenerative principle employed. Milk vendors usually take from seven to eight hours to heat and cool their milk, whereas with this appliance they can do this far more effectually in a half hour or an hour, and thus send their milk to town twice a day instead of only once, and realise its value quickly instead of waiting for the longer process and slower return of butter and cheese-making. MM. A. Arnoult et Fils, who send large quantities of milk to Paris daily, state that with a single combined apparatus, such as that described above, they can heat to 90° Cent. (194° Fahr.) and then cool to 11° Cent. (52° Fahr.) 6000 litres (1320 gallons) of milk in an hour, the water serving for refrigeration being constantly at 10° Cent. (50° Fahr.). Messrs. Lawrence and Co. have lately erected works at Lille for the manufacture in France of this apparatus, which they also exhibited at the Paris Cattle Show.

## GARRETT'S SELF-ACTING DRUM-GUARD.

WE need hardly remind our readers that there is an Act for the prevention of accidents by threshing machines, the requirements of which are very specific. They insist that the drum and feeding mouth of every threshing machine shall at all times during working be kept sufficiently and securely fenced, so far as is reasonably practicable and consistent with the due and efficient working of the machine, and the Act imposes some smart penalties for infractions of these requirements. Amongst others Messrs. Richard Garrett and Sons, of Leiston, sought to meet these requirements, and they have very effectively succeeded in so doing by means of the self-acting drum-guard which we illustrate herewith in longitudinal and cross section. Upon reference to our engravings it will be seen that the bottom of the well, in which the attendant stands when feeding the machine, is hinged on one edge, and is connected at the opposite side to a cord which passes over a pulley, and is hooked on to a bent lever which is fixed to the guard. The guard when closed entirely covers the opening to the drum. It is hinged on the side furthest from the attendant, and when he steps into the well his weight depresses the false bottom of the latter to its horizontal position, and in so doing raises the drum-guard to the position shown by the dotted lines. When, however, the attendant leaves the well the guard at once falls by its own weight, and protects the drum thoroughly. An opening through which the loose corn can be swept in is left when the guard is closed. It will be seen that the whole arrangement is very simple, and equally sound, as it is only when the attendant is in his position and feeding the machine that the guard is raised. Even then, although lifted sufficiently high to admit of the process of feeding, it forms an efficient protection to those engaged in carrying on the threshing operations.

## THE "AMATEUR" BOILER.

IN the accompanying engraving we illustrate a cheap and effective little boiler for hothouse purposes, which has been designed and is manufactured by Mr. J. Watson, of St. Albans, Herts. It will be seen to consist simply of a wedge-shaped chamber fitted with circulating pipes and a cock, as shown.



The boiler is enclosed in a brick furnace with an ashpit beneath, so arranged as to be easily set by any ordinary bricklayer. The advantages claimed for this boiler are, in the first place, that the lower part being circular, the water and sediment can be drawn clean off, rendering it free from corrosion or burning. Next, the sides being at an angle, the fire has more power on the boiler, and there is also more room left for fuel. The top being angled, the fuel passes down to the grating with certainty, rendering the fire not liable to fail. The boiler is most conveniently supplied with fuel at the top, and the flue is so constructed as to be self-feeding, although when room is an object fuel may be supplied from the front. This boiler is well spoken of by several practical users who have tried it in houses from 20 feet to 50 feet in length.

## THE PREPARATION OF MALLEABLE NICKEL AND COBALT.

NICKEL and cobalt, prepared by the electrolytic method, though slightly malleable, become brittle and porous on being melted and cast, resembling in all properties the metals prepared by the ordinary dry method. M. Fleitmann*, thinking that the want of tenacity was due to the combination of the metals with carbonic oxide, tried the experiment of adding to the metals, while in a fused state, a small quantity of magnesium. This metal has the property of reducing the oxygen compounds of carbon in virtue of its affinity for the former element. He began by adding 1-8th of a per cent. of magnesium, and was surprised to find that it effected a great change in the nature of the metals. After this treatment they are capable of being forged and rolled into sheets, either hot or cold, with facility. Cobalt by the latter treatment becomes extremely hard. Cast and cooled in moulds, both metals are similar in all respects to cast steel. When polished they retain their brilliancy in air unimpaired, and contrary to what is usually stated in the text-books, cobalt surpasses nickel in lustre and whiteness. The metals retain in the form of alloy about one-half the magnesium that has been added. Whether or not the important modifications observed are due to this small proportion of alloy does not seem to be satisfactorily proved.

## EXPERIMENTS TO ASCERTAIN THE ACTION OF WATERY VAPOUR ON CARBON AT DIFFERENT TEMPERATURES.

By C. G. DAHLERUS.

AS it is necessary, in order rightly to understand the occurrence of hydrogen both in furnace and generator gases, to have some knowledge of the temperature which is required for the combustion of carbon with watery vapour, and in general of the circumstances which influence the combustion in question, I undertook some months ago, at the request of Professor Åkerman, to make some experiments on this point at the laboratory of the Stockholm School of Mines. These were carried out by passing watery vapour through a heated tube filled with charcoal, and by collecting and analysing the gases that were thus formed.

A boiler of about 150 cubic centimetres' capacity, provided with a small mercurial manometer, was used for producing the steam, which was passed through a tube provided with a stop-cock for regulating the speed with which the steam passed into the tube filled with charcoal. This tube, which was 1·5 c.m. in diameter and 1 metre in length, was placed in a combustion-furnace 58 c.m. long and having twenty jets. The tube was so placed that, at the side where the steam entered, 16 c.m., and at that where the gases were taken out 26 c.m. of the tube were out of the furnace in order to protect the corks inserted in both the ends from burning. In order to determine the temperature inside the tube there were placed at three different points, viz., in the middle and at the distance of 15 c.m. from either end of the portion of the tube within the furnace, trays of steatite containing pieces of Mayerhofer alloys with different melting points. These trays had each a length of 5 c.m. The other part of the tube intended to be heated was filled with pieces of charcoal of such a size that they passed through a sieve with holes of 0·75 c.m., but were retained by one with holes of 0·35 c.m. The determinations of external temperature were made with a hydropyrometer, the ball being placed by the side of the iron tube, and the determinations always made when the ball had the same colour as the tube. The velocity of the steam was in all the experiments so proportioned to the height of the gas-jets by which the tube was heated that as much heat was conveyed to the tube as was carried away from it, so that the same alloy always remained unfused in all the three trays. The gases which were formed were led through a spiral gas-tube in order to condense the steam, the tube being divided at its end into two, so that the water was conducted downwards through a vertical tube into a graduated cylinder, while the permanent gases were led upwards and collected in a graduated cylinder filled with water, or were received into an Orsat's apparatus in order to be analysed. As no sample of gas was taken until the experiment had lasted at least two hours, it is assumed that the content of atmospheric air found in some of the analyses has arisen from the air in the tubes and in the Orsat apparatus not having been completely removed, and the content of air has therefore been deducted from the analyses.

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* Berichte der Deutschen Chemischen Gesellschaft.

When watery vapour burns carbon to carbonic oxide, there are formed from two volumes of watery vapour two volumes of carbonic oxide and two volumes of hydrogen. Further, when carbon is burned by watery vapour to carbonic acid, there are formed from one volume carbon and four volumes watery vapour, two volumes carbonic acid, and four volumes hydrogen. Consequently the volume of hydrogen in the gases ought to be equal to the volume of carbonic oxide and double that of the volume of carbonic acid. The gases have, however, as their smell indicated, always contained carburetted hydrogen, and in this way may be explained why the percentages of carbonic acid and oxide and those of hydrogen, calculated in the way just stated, do not always make 100.

The experiments were at first carried on in the following way. After the tube had been filled and the different parts of the apparatus connected together and the water in the boiler brought to the boiling point, the gas under the tube was lighted with as small a flame as possible, and afterwards raised a little every half hour, until the heat was so great that combustible gas escaped from the tube, after which the jets were kept at the same height. After the experiment had gone on in this way for one or two hours, the pressure of the steam being kept as uniform as possible, samples of gas were taken, which were analysed. During the same period, determinations of external temperature were made. Afterwards the experiments were made in a different way. After combustible gas had been obtained with the smallest possible flames and samples had been analysed, the jets were raised somewhat at the expiry of each half hour. Between every raising of the jets samples of gas were taken and determinations of external temperature made. Finally, experiments were made in such a way that with the highest possible temperature the pressure of the steam was lessened until no water passed out of the tube in an undecomposed state. The results of these experiments are shown in the following table:—

| Number of the experiment. | Pressure of steam. | Water condensed and collected. | Combustible gas formed. | 100 volumes of combustible gas contained. | | | Total gas. | Temperature in Centigrade deg. | |
|---|---|---|---|---|---|---|---|---|---|
| | Lines mercury. | Cubic c.m. per minute. | | $CO^2$ vol. | CO vol. | H (by calculation) vol. | vol. | External. | Internal. |
| 1 | 2 | 0·4 | 0 | — | — | — | — | 400 | 400 |
| 2 | 2 | 0·33 | 10 | 30·7 | 3·6 | 65·0 | 99·3 | 500 | 450 |
| 3 | 2 | 0·22 | 10 | 25·3 | 10·6 | 61·2 | 97·1 | 500 | 450 |
| 4 | 1 | 0·05 | 2·5 | 24·3 | 12·0 | 60·6 | 96·9 | 500 | 450 |
| 5 | 0·5 | 0·00 | 1·33 | 21·6 | 16·8 | 60·0 | 98·4 | 500 | 450 |
| 6*a* | 1 | 0·07 | 25 | 31·1 | 3·3 | 65·5 | 99·9 | 500 | |
| 6*b* | 1 | 0·07 | 33 | 26·3 | 8·6 | 61·2 | 96·1 | 675 | |
| 6*c* | 1 | 0·07 | 36 | 25·8 | 10·3 | 61·9 | 98·0 | 750 | |
| 6*d* | 1 | 0·07 | 60 | 24·2 | 11·6 | 60·0 | 95·8 | 800 | |
| 6*e* | 1 | 0·06 | 100 | 23·0 | 15·0 | 61·0 | 99·0 | 850 | |
| 6*f* | 1 | 0·05 | 300 | 21·6 | 15·5 | 58·7 | 95·8 | 900 | 900 |
| 7*a* | 2 | 0·30 | 54 | 28·7 | 3·6 | 61·0 | 93·3 | 700 | |
| 7*b* | 2 | 0·27 | 150 | 25·1 | 12·3 | 62·5 | 99·9 | 750 | |
| 7*c* | 2 | 0·17 | 200 | 22·5 | 15·3 | 60·3 | 98·1 | 900 | 900 |
| 8 | 1 | 0·05 | 170 | 15·8 | 26·3 | 57·9 | 100·0 | 900 | 900 |
| 9 | 0·5 | 0·00 | 160 | 14·2 | 28·6 | 57·0 | 99·8 | 900 | 900 |

On examining this table it appears that watery vapour is decomposed at a temperature which is indicated by the alloys as from 450° to 500° C., but the temperature may, in fact, not have been higher than 400° C., because zinc in the interior of the tube was not fused in any of the five first experiments. Further we see that the greater the excess of watery vapour the richer in carbonic acid are the gases; or in other words, that carbonic oxide is very easily burned to carbonic acid by means of watery vapour, and that the content of carbonic oxide is increased both by a lessened excess of watery vapour and by the raising of the temperature, and that the best gas is thus obtained by raising the temperature as high as possible and by a moderate supply of steam.

In connection with this some experiments have also been made to determine the temperature at which carbonate of lime begins to give off carbonic acid. These experiments have shown that the carbonate of lime begins to become caustic at a temperature which, as indicated by the alloys named, lies between 550° and 600° C.; but that pieces of the same size as that of the charcoal employed in the former experiments, when heated in a current of air of 900° C., did not become completely caustic after the lapse of six hours.

## OCCASIONAL NOTES.

### CHEMISTS AND THEIR CHARGES.

THERE is a well-known story of a sailor and a Wapping apothecary, in which the popular impression with regard to the unnecessary costliness of prescriptions is embodied, and in a letter to *The Times*, last week, "A Physician" clenches the time-honoured anecdote with facts perhaps more authentic. He says that a short time ago a friend staying in his house was charged 3s. 6d. for a six-ounce bottle of medicine, the contents of which proved on analysis to consist of a drug costing exactly three-halfpence made up with sugar and water. This is just about the same proportion of price to cost as the Wapping apothecary's nostrum, for which he demanded half-a-crown, and on the sailor laying down twopence and running off, shouted after him that he had still three-halfpence out of the transaction. The "Physician" adds a wrinkle which may be of service. He explains why chemists' charges, although so entirely arbitrary, should yet be so very uniform. Let any one, he says, scrutinize the next prescription returned from any chemist's shop, and he will find near the dispenser's stamp two or more mysterious letters, which have been placed there for the purpose of informing the chemist next employed what charge was last made. If those letters are effaced the same marvellous uniformity will not be found to prevail. It is by these cabalistic signs that trade prices are kept up, so that the wholesome principle of competition is comfortably excluded.

### NOXIOUS VAPOURS.

That the noxious emanations from chemical works have proved a serious nuisance to certain influential classes in their neighbourhood guarantees that a strong effort will be made to carry through the measure just introduced by Government on the subject, and that thus the public health will be more effectually safeguarded—a matter of still greater importance than the amenity of private pleasure grounds. The Government Bill on the subject extends the principle of law already adopted in the case of alkali manufacturers to other traders of a similar kind, and is nearly identical with that introduced in the last session of Parliament, which met with scarcely any opposition, but was shelved at a late period of the session by a handful of adversaries placing a notice against the second reading, when it was impossible to find time for a second discussion. One result of the delay, which probably the parliamentary tacticians in question did not anticipate, will be increased and not unnecessary stringency, and better machinery for prosecutions. Much of the inefficiency of the Alkali Acts, although they have not been wholly ineffectual, has been owing to the fact that a great many of the sufferers by unhealthy emanations from chemical works have not been in a position to put the Acts in force, and they have therefore remained so far a dead letter. They might have been wholly so but for the exertions of Dr. Angus and the other inspectors.

### EUROPEAN ENTERPRISE IN AFRICA.

The Italians have lately acquired a foothold in North-eastern Africa, and there are projects afoot of intercommunication between the south-eastern portion of the Continent and its central territories by way of the Zambesi and the Great Lakes. The Zanzibar route must, however, be the principal one in the East. On the western side there is Mr. Mackenzie's route to Timbuctoo, and the proposed railway in the same direction from Algeria, which the French are prosecuting with characteristic *élan*. Dr. Delamotte, a French savan in the service of the Khedive, has started a project of the engineering sort which, if it could be carried out, might be expected to raise the ancient granary of Europe to more than its former productiveness. Dr. Delamotte is of opinion that the dried-up river beds which are found in the desert country on the borders of the narrow valley irrigated by the Nile, were fed, in prehistoric times, by a lake covering the plateau of Khartum, but which was, on the wearing down of the rocks forming the cataracts, entirely thrown into the present bed of the Father of Waters. Dr. Delamotte proposes to raise the level of the cataracts by a system of dams and locks, turn a portion of the inundation into the Bahr-e-Abiad, as the empty water-courses are termed by the Arabs, and thus, by rendering the desert again fruitful, increase tenfold the harvests of Egypt. The Khedive is said to be caught by the scheme, and its ingenious projector would have been a decided acquisition to that select circle of mechanicians and philosophers among whom Rasselas passed his youth.

### SHIPS AND SAILORS.

Without denying the accuracy of Mr. Plimsoll's charges, it must, we think, be admitted that carelessness and defective seamanship have a good deal to do with many marine disasters for which owners get much of the blame. The latter failing can perhaps best be met by a proper training; and it is therefore satisfactory to find that in his very able address on Friday last the chairman of the Chamber of Shipping brought the question of the resuscitation of the practice of apprenticeship before the meeting. Another important matter is the selection of officers. This is too often done in a hap-hazard way and in a parsimonious spirit. The fact of the Cunard steamers having crossed the Atlantic for forty years without losing a passenger, or even a letter, committed to their care, shows how safe the sea might be made. The question of the stowage of cargoes of grain was of course brought fully before the Chamber, and resolutions regarding it were passed. It was argued that it was equally dangerous to carry grain in bags in some ships as in others in bulk, and proposed that the Merchant Shipping Act should be altered accordingly; and it is probable that Mr. Plimsoll's proposed amendment of that Act will be thus met. From what transpired, however, it would seem as if Parliament ought to go into the matter more thoroughly than it is likely to do, or to be able to do, this session; for it is plain that several of the arrangements already made are worse than ineffective, and that they are evaded by courses which render them rather additional sources of danger than measures of safety.

### DISTANT COUSINS.

In the mountains bordering the Kyber and the Cabul valley, there dwells a race of mountaineers, "pent in that fortress" of Northern Afghanistan, who yet have been able to hold their own against the Mahommedans of the plains, who continually harass them, partly from bigotry, but chiefly to obtain their youth of both sexes as slaves. These kafirs, or infidels, as they are termed by their Mussulman neighbours, are as white as Europeans, whom they resemble in feature. They number nearly a million, and are frequently described as the descendants of Greek colonists, planted at Candahar and other cities by Alexander, although that has been disputed on apparently good grounds. They are brave and hardy, and have long been desirous of the alliance of the English masters of India, with whom they claim kindred. It seems a pity that the "scientific frontier" should not be extended so as to include the natives of Kafiristan amongst its defenders. Major Gordon, who has recently advocated the claims of this interesting people, states that their country teems with mineral wealth, containing, among other products, ruby mines of great value, and believes that it yet possesses numerous remains of Greek art. It has long been inaccessible to strangers, and whatever the origin of its people, the study of their customs, traditions and language would probably throw much light upon the history of the Aryan race; while the investigation of the natural history of the tract, which is already known to possess a flora including numerous European or allied forms, could hardly fail to give valuable results.

### RAILWAY ACCIDENTS IN AMERICA.

The annual return of train accidents in the United States, in 1879, shows a material increase over the preceding year in the number of accidents, but a decrease in the roll of killed and injured. The number of the former was 185, and of the latter 709. No cognizance is, however, taken in the return of injuries done by trains to trespassers and others on the lines, or to passengers by falling from carriages, which constitute by far the greater number of railway accidents both in this country and America. As far as the present returns are concerned, the number of killed and injured is considerably less than in any previous year in recent times, notwithstanding the development of the railway system. The increase in the number of accidents is, however, a serious feature, the gravity of which is not lessened by the fact that an augmented proportion was due to collisions. But much the greater number were occasioned by trains leaving the rails, the ultimate cause frequently in both cases being breaking of the trains in two, in all probability from the lengthening of them without proportionately strengthening the draw-gear. The *Railroad Gazette*, in commenting on these returns, asserts that only a fraction of the whole number of railway casualties is ever reported, excepting in the case of train accidents that cause loss of life or serious personal injury. The other and more largely fatal accidents which take place at crossings or on other parts of the line from passing trains, and the probably still more numerous ones connected with the coupling and uncoupling of carriages and other operations in the stations, are very imperfectly reported; and the fatalities from being run over must be much greater in the States than in England, owing to insufficient fencing of the lines and the recklessness of the public in entering and leaving the carriages while the train is moving.

# IMPROVEMENTS IN MACHINERY FOR ROLLING IRON AND STEEL PLATES.*

By Mr. EDWARD HUTCHINSON.

BEFORE proceeding to describe the nature of the proposed improvements, it will be well to notice briefly the method generally adopted at present in rolling plates, as compared with that in use for producing flat bars, angles, or other sections. These latter forms of manufactured iron are produced by means of rolls with several grooves of gradually decreasing sectional area cut on their surfaces, so that generally two, and sometimes three pairs of rolls are required to contain the number of grooves or spaces necessary. Thus the production of large sections of angle, tee, channel iron, &c., is very expensive on account of the first cost of the rolls, in cases where the section is an unusual one, and the quantity of lengths required is not large. On the other hand, as the bar is rolled to its exact section, and in forming the pile no allowance need be made for waste in shearing (except so much as is necessary to ensure a clean end to the bar), the cost per ton rapidly diminishes with the increase in quantity produced. Thus, of all forms of rolled iron, double-headed rails are the cheapest; then follow the commoner sections of angle-iron, &c., used in shipbuilding, whilst the most expensive forms of all are the heavier sections of channel and joist iron, the cost of which is not only augmented by the ordinary difficulties attending their manufacture, but also, and perhaps to a still greater degree, by the smallness of the quantity required at one time.

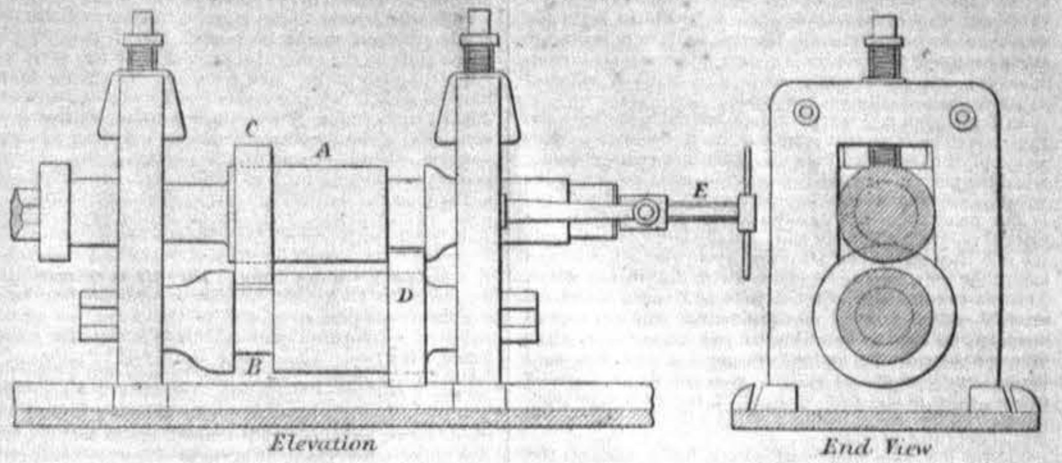
With plates another state of things exists, and totally different conditions have to be taken into account in estimating the cost of any given specification. Here the cost of the rolls is not to be considered, nor is the quantity required at one time of much importance. The chief point affecting the cost of production (supposing the specification only to require plates of ordinary length, breadth, and thickness) is the variable proportion of waste in rolling plates of different widths and lengths, due to the fact that plates are not rolled, like bars, to their exact dimensions, but between plain rolls, and therefore a certain width must be sheared off each side, as well as off the ends. In the trade a bar is supposed not to exceed 8 or 9 inches in width. All widths above this are taken as plates unless specially ordered as bars; most large bar-mills now rolling bars up to about 12 inches wide if required. Bars above this latter width become very expensive, chiefly on account of the number of rolls which would be required for intermediate widths, as well as the great number of sections of puddled bar which it would be necessary to provide. All above 12 inches wide, and many under, are therefore rolled as plates, and sheared on the sides as well as the end. The process may be described as follows:—A pile is made of puddled bar and of scrap, the latter composed of the shearings off finished plates. The puddled bars are generally from 12 to 18 inches wide, the width being regulated to some extent to that of the finished plate intended to be produced. After being heated the rough pile is first put through blooming rolls, to close the edges, and to compress and solidify the mass. It is then usually turned sideways to the rolls, and put through the roughing rolls as many times as are necessary to bring it to the required width) allowing a margin for shearing, and for inaccuracies as to straightness, &c.; it is then turned again and gradually elongated, partly in the roughing and partly in the finishing rolls, until brought down to the required gauge, regardless of its length.

In order to insure a perfect plate, it is necessary to allow say at least 3 inches on each side in a strip of fair length; so that for a 12-inch plate more than 30 per cent. of the rough strip is cut to waste on the edges alone. In other words, whereas a pile of 6 cwt. would be heavy enough to make a bar of a given weight 12 inches wide, a 9-cwt. pile would be required to produce a sheared plate of corresponding dimensions. With plates at £8 per ton, and scrap iron at £3 per ton, this extra waste would amount to a clear expenditure of 50s. per ton of finished iron in waste of materials alone. This difference of course decreases as the width of the bar or plate increases, because the proportion which the allowance for waste bears to the whole mass becomes less and less the wider the plate. In all cases, however, a very liberal allowance must be made to ensure a sound edge; notwithstanding which there is a very great loss in all plate mills, due to the proportion of plates which, owing to defective edges, will not cut to the size required. In steel, the difference in value between the finished plate and the scrap is, of course, greater than in iron; and the resulting loss is more serious in the like proportion. In order to overcome these objections to the prevailing method of rolling plates, at least as regards narrow plates, the mill known as the "Universal Mill" was devised. It has also been called the Belgian Mill from its frequent adoption in Belgium. In this country it has not been generally successful, owing chiefly, it is believed, to the objection English workmen have to novel appliances, or rather, perhaps, to the difficulties which manufacturers in this country experience in adopting labour-saving machinery. The writer, however, has had an opportunity of judging of its merits during several months' fair work at the Britannia Works at Middlesborough-on-Tees.

The construction of the Belgium mill is not in a strict sense of a complicated nature. When, however, we consider the great strength required for every part of this class of machinery, the rough usage, and the enormous cost of break-downs, and delay, we shall find that there are certainly more parts requiring careful adjustment about the Belgian mill than is consistent with the highest economy in production; in other words, if bars could be rolled in ordinary rolls of the same widths as in the Belgian mill, the latter could not compete with the former in point of economy.

The Belgian mill is simply an ordinary mill with a pair of vertical rolls behind the horizontal ones. These catch the plate as it leaves the horizontal rolls, and compress the edges sufficiently to close and solidify them. The surfaces of the vertical rolls move a little faster than those of the horizontal rolls. In practice it is not found desirable to compress the edge much more than is just about sufficient to preserve the width, without decreasing it; and the piles are generally made about the same width as the finished plate is intended to be. This implies the necessity for great diversity of width in the puddled bars, a difficulty which is usually got over in Belgium by using several narrow bars of variable width to form the tops and bottoms of the piles. Thus from a stock composed of 5, 6, 7, and 8 inch puddled bars, piles of all widths above 10 inch could be built up, rising by inches. It is, however, impossible to admit that a plate so made, *i.e.*, with a welded instead of a solid surface, can be so sound or so uniform in tensile strength across the grain as one produced in the ordinary way.

## MACHINERY FOR ROLLING PLATES.



Elevation

End View

Most Belgian mills, probably with a view to avoid expensive complications, consist of only one pair of horizontal rolls working in combination with vertical rolls; and these are usually in connection with an ordinary plate mill. This prohibits a large production, as the rolls become too hot if the work is continuous. The manipulation of the Belgian mill is by no means a simple matter, nor can it be placed in the hands of inexperienced or unskilful workmen. The slightest maladjustment of the screws, either of the vertical or horizontal rolls, will cause the plate to twist; whilst, if the vertical rolls are allowed to exercise any undue pressure on the edge, it becomes thickened to such a degree that the plate is sure to curve more or less the next time it is passed through the rolls, and any attempt to straighten it afterwards is generally useless. Under any circumstances the action of the vertical rolls is to a certain degree objectionable. The pressure, however slight, has a tendency to open the edge, and the thickening, which it is always difficult to avoid entirely, is for many purposes a serious drawback; as for instance where a number of plates of uniform width are placed in juxtaposition, as in the flange of a large girder.

The difficulty of keeping the plates straight and the impracticability of afterwards straightening them, as already mentioned, will always be an objection of greater or less importance to the general adoption of the Belgian mill. To these may be added its great expense, as well in first cost as in the maintenance. Perhaps, however, the most important point in its disfavour, especially for rolling steel, is the limit to the width of plate that can be produced by it. If the horizontal rolls are 6 feet 6 inches long, and the verticals 2 feet in diameter, 2 feet 6 inches would be the limiting width of plate for such a mill; since the vertical rolls when opened to such an extent come in contact with the standards. This was the limit at the Britannia Works; and plates were rolled there 32 feet long, by 2 feet 6 inches wide, by ¾ inch thick, with perfectly sound and straight edges. No greater difficulty seems to attend the manufacture of wide than that of narrow plates, except a tendency to buckle when the plates is very wide and thin. The housings or standards could be made of a form which would permit the vertical rolls to separate so far that a plate with closed straight edges could be rolled almost as wide as the length of the horizontal roll. But such an arrangement would still further compromise that simplicity which it is so desirable to maintain in machinery of this kind; besides which the guides carrying the vertical rolls, owing to their increased length, would have to be of extremely massive proportions; as indeed would every part of such a mill.

The tendency already already mentioned in thin plates to buckle, or bend up, between the vertical rolls, would require to be obviated, in plates much over 2 feet wide, by some special contrivance. This has not yet been worked out, so far as the writer is aware; and, although it is obvious that such an appliance could be devised, this complication would add very materially to the objections which already exist. The advantages of the Belgian mill may thus be said to be confined to large establishments, where more than one plate mill is in constant operation, and where a quantity sufficient for one mill of plates under about 2 feet 6 inchas in width may always be selected from the orders in hand. Under such circumstances a very considerable saving may be effected. Whether or not it could be profitably applied to all classes of work is a problem which could be solved only at very consderable expense.

The annexed engraving shows the general construction of a sliding roll mill, designed to accomplish the same object as the Belgian mill, without being open to any of the more serious objections to the use of the latter. The construction of this mill may be thus described:—The ordinary rolls of a plate mill are removed, and in the same standards a pair are substituted of the form shown. It will be seen that the top roll, A, and the bottom roll, B, are nearly alike in form; and that a collar, C, is placed on the top roll, A, and a collar D, on the bottom roll, B. These collars are not cast solid on the rolls, but are capable of sliding along them; being held, however, in one position, as regards the other roll, by corresponding grooves. Applied to the end of the top roll A is a powerful screw, E, which takes its thrust from the top check, F, and consequently rises or falls as the top roll is adjusted in height. By working the screw, E, a motion in the direction of its length is given to the top roll, A, its necks being of such a form as to allow of this motion; whilst the bottom roll, B, remains firmly fixed endways between the standards. End motion being given to the top roll, A, it will carry with it the bottom collar, C, whilst the top collar, D, remains stationary; and by this means the distance apart of the two collars is adjusted *ad libitum*, being limited only by the travel allowed to the top roll, A, in the direction of its length. The engraving shows the form of a box and spindle which has been adopted, and which has been found to present no inconvenience. The rolls are adjusted vertically in the usual way, but clearly they must not be allowed to open so far as to draw the collars out of the grooves.

As this system of rolling is applicable to every stage of the process—forge rolling, blooming, roughing down, and finishing—and to steel from the ingot as well as to iron from the pile, it will be necessary to describe it in connection with all these separately, as it will be found that there are certain points in each requiring special consideration.

Firstly, as to forge rolling. It is at all times inconvenient to use very wide piles, on account of their not heating uniformly, and of the space and height required in the furnace to allow of their being turned: hence it will probably be found that rolls arranged to roll puddled bars varying in width from 12 to 24 inches will meet all requirements. The collars and grooves would have to be of such a size as to allow of a vertical adjustment of about 5 inches. Such a mill would be an extremely simple affair, and need not be further described; but its use would be attended with great advantage in connection with all plate mills, whether the bars were to be afterwards used in mills of the same construction or not. The same may be said as regards mills rolling large sections of bar iron, as the same pair of rolls would produce bars of any width, obviating the necessity for frequent change of rolls.

Secondly, with regard to Blooming. In some mills this operation could be advantageously combined with roughing down, and both operations done in the same rolls, the latter process being in fact but a continuation of the former. Where large plates were made, however, this would be found impracticable, as sufficient vertical adjustment in the top roll could not be obtained in one pair of rolls without cutting very deep grooves, and so leaving the roll dangerously weak. It is therefore necessary to have blooming rolls with a vertical adjustment in ordinary mills of about 5 inches, so that, taking a pile 12 inches deep, they would squeeze it down at once to 10 inches, and then by successive adjustments of the rolls to a minimum thickness of 7 inches, at which the roughing rolls are calculated to deal with it.

Thirdly, as to roughing down. This, as already stated, is simply a continuation of the blooming process. It must be remarked, however, that provision has only been made for puddled bars up to 2 feet wide, and perhaps even this is somewhat in excess of what could be used with due regard to economy of height and space in the heating furnace: hence all plates above this width would have to be rolled with their length in the direction of the width of the pile. There is no objection whatever to this, and it is frequently practised for convenience sake in ordinary plate rolling. In these cases the length of the pile would correspond as nearly as may be with the width of the plate.

Fourthly, as to finishing rolls. These are made with still smaller collars than the roughing rolls, the adjustment necessary being extremely limited, say from 1-inch to ½-inch; in other respects the rolls are of the same general form. It will be seen that it is impracticable to provide for more than a limited length of travel for the top roll in any case, but more especially is this true of the finishing rolls, where the pressure in rolling is greatest; otherwise the rolls would become dangerously small in diameter in proportion to their length. In practice it will probably be found that a travel of about 2 feet will be as much as is convenient. So that, beginning at 12-inches width, one pair of rolls would finish up to 3 feet and all intermediate widths. Another pair would begin at 3 feet, and with a travel of two feet would finish up to 5 feet, covering all intermediate widths. Where two mills were in constant operation, the one could be kept on the narrower and the other on the wider plates; but where only one was in use, the rolls would have to be changed occasionally, probably not more frequently than once a week.

The relative merits of this system of rolling as compared with those of the Belgian mill may be briefly noticed. It will at once be remarked that no real side compression can be given to the pile when rolled in this way. In practice, however, this cannot be effected even with the vertical rolls in the Belgian mill; nor is such compression necessary or desirable, as the pressure of the main rolls is quite sufficient to squeeze the piece laterally to such an extent as to make it fill the space between the collars in the one case, and between the vertical rolls in the other, and so form a close sound edge. But whilst in the Belgian mill the plate is subjected first to vertical pressure by the main rolls, and afterwards to lateral pressure by the vertical rolls, in the sliding-roll mill the side and surface pressures are simultaneous; and consequently no thickening of the edge or other similar imperfection is possible.

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* Read before the Institution of Mechanical Engineers, January, 1880.

In the Belgian mill the pile must invariably be put into the rolls endwise, so that every pile must be made as wide as the plate to be rolled from it. This is a great difficulty when the plate is over 18 inches wide, and, so far as the writer is aware, has yet to be overcome. The collared roll is also much more readily adjusted to width than are the vertical rolls of the Belgain mill. In the latter case not only the rolls themselves but also the guides, both before and behind the rolls, have to be adjusted with the greatest nicety. This causes considerable loss of time and waste of fuel and material, as after every re-adjustment one or two experimental plates have to be rolled to test its accuracy. The difference between the two mills in point of first cost need hardly be pointed out. The sliding-roll mill does not greatly exceed, either in first cost or working expenses, a mill constructed on the present model; whilst a Belgian mill would cost about twice as much.

Lastly, the rolling of steel plates by means of the machinery described will obviously present no difficulties. This point has already been alluded to; but inasmuch as rolling iron from a pile is a much more complex operation than rolling steel from a solid ingot, the former process has received for the present the most attention, more perhaps than its declining importance deserves. Steel plates must sooner or later be used, to the very general exclusion of the inferior material; and it is confidently believed that the adoption of the process described would go far to lessen the great difference at present existing between the cost of making steel plates and that of making iron plates of an equal weight.

# CANTOR LECTURES.

## DWELLING-HOUSES: THEIR SANITARY CONSTRUCTION AND ARRANGEMENTS.

By Professor W. H. Corfield, M.A., M.D. (Oxon).

### Lecture V.

*Sewerage, Main Sewers and House Branches, Traps. Ventilation, &c.*

EVEN where conservancy systems are used for the removal of refuse excretal matters, it is necessary to have some contrivance by means of which the foul waters can be got rid of. In country places, it may be discharged into ordinary agricultural drains laid beneath the garden. It then percolates into the soil, and serves to fertilise the crops. If, however, such waste water is thrown gradually down the traps and into the drains, a small quantity at a time, the water escapes through the junctions of the first few pipes, and the fat and other solid matters become deposited in them, and soon choke up the pipes; so that it is necessary to collect the slop-water, and discharge it at intervals. The best contrivance for this purpose is Mr. Rogers Field's flush tank, of which I have here an actual specimen and a large working model kindly lent by Mr. Field. The slop-water is discharged over a loose iron grating at the top, and passes through a funnel-shaped aperture with a syphon bend at the bottom of it, which can also be lifted out, into the tank below. The discharge pipe from this tank does not start from the top of it, but very near the bottom, is carried upwards to the top, and turns over and passes downwards to its outlet, which is at a lower level than the point from which the pipe began. This pipe is made in the earthenware end of the tank itself. Thus it will be seen that a syphon is produced so that when the tank is filled to the top, and the shorter limb of the syphon also filled up to the bend, a sufficient quantity of water thrown in suddenly will start the syphon, and so empty the tank of its contents to the level from which the lower limb starts inside the tank. The discharge end of the syphon has a weir placed across it with a notch in it. By means of these contrivances, not only will a smaller quantity of water start the syphon, but a false action, which was found occasionally to take place, and which caused the water to dribble away without the tank being emptied, is prevented. Thus the whole body of water contained in the tank is made to rush through the drains, and the difficulty spoken of above is avoided. The tank also acts as a very good fat trap. In towns, however, it is necessary to have sewers for the removal of the foul water. Sewers ought to be impervious to water, so that their contents may not percolate into the soil around, and so drains which are made to dry the soil are obviously not fitted to be used as sewers. The larger sewers are usually made of bricks, and built with an oval section, this being preferable to the circular, and of course far better than any rectangular section. The bricks should be of the very hardest kind, and set in cement, and it is advisable to build the "invert," or lower part of the sewer, upon invert blocks made of stoneware. For smaller sized sewers stoneware pipes are the best. They should always be used for sewers not greater than 18 inches in diameter. Larger sewers than these are cheaper made with bricks set in cement. Stoneware pipe sewers would be much more used than they are in towns, but for the fact that the estimated size of the sewers generally is usually larger than is required, and much larger than would be required if the rain and surface water were carried away by separate drains. The pipe of the sewer only requires to be large enough to carry away the water that can be discharged into it, and anything beyond that size is an absolute disadvantage, as it makes it more difficult to flush the sewers properly, for a larger pipe is insufficiently flushed by a quantity of water that would easily flush a smaller one. For flushing purposes it is best to have an arrangement by which a considerable quantity of water is delivered into the sewer at once, so that it may fill it, or nearly so. The same quantity of water delivered more gradually does not produce by any means the same effect. In laying sewers, whether main or house sewers, provision should always be made for making new connections without cutting into the pipes. This may be done by putting in junctions at various points—a plan especially suited for private estates, where the points at which junction may be wanted will suggest themselves. With street mains more ample provision should be made. Mr. Jennings's pipes, which allow of the sewers being opened at any point without cutting the pipes, may be used. The pipes, in fact, have no sockets, the place of the sockets being supplied by divided rings, in one-half of which the pipes are laid at their junctions, while the other half covers the upper part of the junction. With ordinary socket pipes, Messrs. Doulton's lidded pipes may be used with advantage. In these a third of the pipe can be taken off along the whole length of the pipe, and so junctions can be made, the pipes inspected, and cleaning rods pushed down them when necessary. The "capped" pipes made by Messrs. Jones and Company, of Bournemouth, are also useful. They are constructed in the following way:—A semi circular or semi-elliptical hole is cut out of each pipe at its end, so that when the pipes are socketed a circular or elliptical hole is left at the junction between the two. These holes are closed by means of lids made for the purpose, which may be removed at any time, for the purposes of inspection, inserting a junction, &c. The above remarks apply to house branches as well as to main sewers, and it is very important not to omit the insertion of inspection pipes, of some kind or another, at proper intervals and suitable places, in house sewers, especially those of large mansions.

The main sewers should be freely ventilated at the level of the streets. All attempts to ventilate them in any other manner have been, without any exception, signal failures. If the ventilators, whether of main or of branch sewers, cause a nuisance it is because there are not enough of them, or because the sewer is either badly laid or not properly flushed. In country places especially, cesspools are often the destination of the house sewers. Cesspools should never be made where it can be helped. It is far better to use the sewage on the land than to collect it in cesspools. However, in some cases cesspools are necessary, in which case they should always be made impervious to water, by being built of bricks set in cement and rendered in cement. The cesspool should not be under the house, but at some distance, and it must be ventilated. If near to the house, the ventilator should be carried up outside the wall of the house, and above the ridge of the roof. If at some distance, it may be ventilated either by means of an open galvanised iron grating, or by means of iron pipes carried up a tree, and covered with wire network at the top. The cesspool should not overflow stream, or drain running into a stream, but on to the surface of the ground; and it is folly to build a second cesspool, as some people do, for the first one to overflow into, for, by the same argument, one might build any number—one after the other. Brick sewers should never be used under houses. The foul water soaks through them into the soil, and sediment is liable to accumulate in them. Rats eat their way through them, displacing the bricks and wandering about the house, and so not only does foul water get out of them into the soil, but foul air finds its way wherever the rats go, besides the fact that rats carry filth from the sewer itself about the house, and into the larder if they can get there. In this way, I have no doubt whatever, that milk and other foods have disease poisons frequently conveyed to them. Sewers made of glazed stoneware pipes should always be used for houses, except in cases where it may be better to use iron pipes, and they should always be laid outside the walls of the houses whenever it is practicable. They may require to be laid in a bed of concrete, as for example, where there is much made ground, or to be laid on hollow invert blocks in very wet soils. They should be jointed with cement, or, where a settlement is feared, with clay, finishing with a ring of cement. Clay alone is not advisable, as it is apt to get washed out of the joint, in which case the water runs out into the soil, and the solid matters accumulate in the sewer. If pipes, with Stanford's patent joint, made by Messrs. Doulton and Co. (of which I have some examples here), are used, no cement is required. The ends merely have to be greased and fitted into one another. These pipes must be laid straight, or they will not fit together, and at bends it is often requisite to use ordinary socketed pipes. The fall of a house sewer should at least be 1 in 48, but a more considerable fall is preferable; 9-inch pipes may be used for very large mansions, especially if outbuildings are connected with the sewer, but, as a rule, for private houses, 6-inch pipes with 4-inch branches are amply large. The junction of the branches should never be made at right angles, but always at an acute angle, and of course in the direction in which the water is going. At the end of the house sewer, in the main sewer, or cesspool, a swinging flap, made with galvanised iron, is frequently placed, with the view of keeping rats out of the house sewers. It may be of some use for this purpose, but is of little use for preventing the entrance of foul air, and, as may be expected, these flaps are often out of order. It is also usual to place a water-trap of some kind upon the house sewer before it enters the main or cesspool. The kind formerly most used was what is known as the dipstone trap. The drain was deepened at the spot, and a piece of stone or slate inserted right across the drain from side to side, and reaching from the top down into the deepened part, two or three inches below the level of the bottom of the sewer. Water of course always remained in the deepened part, and so the dipstone, running right across the drain, dipped about two or three inches into this water. As it reached also to the top, and was built in, it obviously prevented the passage of the sewer air from the main sewer or cesspool into the house sewer, except, at any rate, that which could pass through the water in the trap. These traps were usually made rectangular, and were often very large, so that they were practically cesspools, and they still go by this name in some parts of the country. They may be much improved by making the end nearest to the house vertical, giving the opposite one a gentle slope, and fixing the dipstone, not vertically, but slanting in the direction in which water goes—rounding off the inside with concrete rendered in cement, so that there are no angles or corners. Thus the water falls vertically into the trap and flows out through a gentle incline. In such a trap very little accumulation occurs. Stoneware syphon traps are, however, now almost entirely used. They are frequently made with an upright piece from the lower part of the syphon, which may be continued by means of straight pipes up to near the surface of the ground, for the purposes of inspection, and of cleaning out the syphon should it get blocked up. This inspection opening is now sometimes made at the end of the syphon which is intended to be placed next to the house, so that if pipes are carried from it up to the surface of the ground, and an iron grating put on to it, a passage is formed which, under ordinary circumstances, acts (if precautions are taken which will be presently mentioned) as an entrance for air into the house sewer. The syphons also are now made with the limb into which the house sewer opens nearly vertical, while the opposite limb has a gentle slope upwards—the effect produced being that already mentioned. It is a considerable improvement, although not absolutely necessary, to increase the air inlet into the sewer at this point, that is to say, immediately on the side of the syphon trap, and instead of merely having a pipe taken up to the surface of the ground, to have a man-hole built in brickwork, and with channel pipes instead of whole pipes running along the bottom of it into the syphon. The channel pipes and one or two pipes beyond should be laid at a considerable fall, so that the water may rush down into the syphon and clear it out as much as possible. Branch pipes may be made to join the main in the man-hole by means of channel pipes, or even by whole pipes discharging into a gutter built above the channel pipe; or they may of course be taken into the house sewer at any point of its course. The man-hole may be covered by a galvanised iron-locked grating, if it is in such a position that gravel, &c., is not likely to get into it, but if in an area it is better to cover it with a locking iron door, and to have one or two 6-inch ventilating pipes from its upper part carried under the pavement area to the wall, up in the wall a short distance, and then opening out by gratings flush with the surface of the wall. A junction pipe should be fixed immediately beyond the syphon and pipes brought from it through the wall of the man-hole, the end being filled with a plug, which can be removed for the purpose of cleaning the sewers beyond the syphon if necessary, or various earthenware disconnecting traps may be used. Potts's Edinburgh chambered sewer trap has the advantage of having a large air-inlet, and a considerable fall in the trap itself. In many instances, with sewers already laid, sufficient fall cannot be got to introduce these traps. Weaver's trap is really a syphon, as already mentioned, with an upright air-inlet leading into the limb of the syphon nearest to the house. Beyond the syphon an aperture is provided by means of which the main sewer, or cesspool beyond, can be ventilated, or which, if merely plugged, may serve as an inspection pipe, through which rods can be pushed, if necessary, down into the main sewers or cesspool. In Buchan's and Latham's traps the fall is quite vertical.

Stiff's interceptor may be described as a syphon-shaped trap, with a double dip, so that it has three compartments, with an open grating for the middle one. If any sewer air should pass under the first dip, it cannot get under the second, which is deeper, but will escape into the open air through the grating. Two inspection openings are provided, which may be also used as ventilating openings—the further one to ventilate the main sewer or cesspool, if necessary at this point, by means of a pipe running to the top of the house, and the one on the house side of the trap may be used as an air-inlet. Professor Fleeming Jenkin has introduced the plan of using two syphon traps with an open grating between them. Dr. Woodhead has modified this by having a large earthenware receptacle, which all the house pipes enter underneath a large iron grating, with two syphons beyond the receptacle, one after another, and an upright pipe with an open grating between them. There is also a smaller upright pipe, with open grating at the top between the receptacle and the commencement of the first syphon. It is unfortunate that we cannot do without a water trap at all in disconnecting the house sewers from the mains, and I certainly do not think that any sufficient reason has been made out for having two traps one after another. At the highest point of the house sewer, or if necessary, at the end of one or more branches, there should be a ventilating pipe, four inches in diameter, carried up above the eaves of the house or above the ridge of the roof, and not under or near any bedroom windows. This may be covered with a little conical cap, or merely with a piece of wire network, or with a cowl (preferably a fixed cowl) if it is required to be ornamental. Whether this pipe be covered with a cowl or not, air will, as a rule, enter at the air inlet at the lower end of the sewer, pass along it through its whole length, and escape by the ventilating pipe or pipes just mentioned, and no foul air can accumulate in any part of the sewer. If any foul air escapes at the air inlets, it acts as a warning to show that something is wrong; the syphon is stopped up, or there is an accumulation of foul matter in it, or in the sewer somewhere. When all is going right, no foul air will escape by these openings. The ventilating pipes may be made of iron if only used as ventilating pipes. When used also as soil-pipes, they are better made of lead, as will be further shown in the next lecture. Rain-water pipes may be taken directly into the house sewer or its branches without any trap, provided that their joints are well filled and packed, and that they do not open at the top near to any bedroom windows, otherwise they must discharge over the surface of the yard or area. The surface gulleys for yards, &c., may be stoneware syphon gulleys, provided with galvanised iron gratings, which are better than stoneware gratings, as they are less liable to break. They are sometimes provided with openings in the side above the level of the water for the admission of waste pipes, &c. Dipstone taps are sometimes used, but are objectionable. McLandsborough's gulley is sometimes useful. It may be described as an iron dip-trap with three compartments, having several openings, into which pipes may be taken above the surface of the water. Jennings's receiver is also often useful, especially where the trap has to be low down, and upright pieces placed one above another over it up to the level of the pavement. Pieces with openings are provided, so that drains coming from the inside of the house—the basement drains for instance—may be discharged into it, and so disconnected from the house sewer. Drains from the basement of a house ought not to open directly into the house sewer, but always into a disconnecting trap of some kind or another. Clark's gulleys are useful where much sludge is likely to be washed into the trap. They are provided with iron buckets that collect the sludge, and can be lifted out bodily. They are doubly and sometimes trebly trapped. The common bell trap, so often used, not only in areas, but in the basements of houses, is a most mischievous contrivance. It consists of an iron box with a pipe, which is connected with the sewer, standing up in it. The perforated cover of the box has an iron cup or bell-shaped piece fastened underneath it. Of course water stands in the box up to the level of the pipe which descends into the sewer. The bell on the perforated lid is so arranged that, when the lid or grating is in its place, the rim of the bell dips into the water around the vertical pipe. Even if the bell is in place, and whole, the trap is untrustworthy, because a very slight increase of pressure of air in the sewer will cause it to force its way through the small film of water into which the bell dips. It is objectionable because it soon becomes filled up with filth, and because, unless water is almost continually running through it, a sufficient amount evaporates to allow the sewer air to escape freely; but the great objection to it is that, when the cover is taken off, the bell is taken off too. The trap, such as it is, is gone, and the air from the sewer escapes freely into the house if the trap is inside the house. The covers are often taken off by servants, and left off, and are also frequently broken, and so the use of these traps should be discouraged as much as possible. The Mansergh trap is frequently useful in areas, as it serves also for the disconnection of the basement sinks, and provides a place of attachment for a ventilator for the house sewer. It consists of three compartments. Into an opening in the side of the first, the waste-pipe of a sink may be conducted. The water from this fills the first compartment up to the level of an aperture, through which it passes into the second, the pipe through which the water is conveyed into the first compartment being made to dip below the surface of the water in that compartment. Over the first and second compartments there is a loose iron lid with a grating over the second or middle compartment. From the second compartment, the water passes under a partition into the third, the outlet from which into the house sewer is above the lower edge of this partition, which itself extends from the top of the trap nearly to the bottom, so that it completely separates the air in the third compartment from that in the second, and dips beneath the level of the water in the two compartments. The top and sides of this third compartment are made of stoneware, so that it does not communicate with the external air, the outlet to the sewer being at one side, and an aperture to which a ventilating pipe may be attached in one of the other sides. Even if the last aperture be plugged up, and no ventilating pipe attached, any sewer air which can pass through the water from the third compartment into the middle one would escape by the grating into the open air, and could not get into the house, as the pipe from the house into the first compartment of the trap dips below the water. The cases in which it is more advisable to use this trap than ordinary syphon gulleys, will be mentioned in the next lecture.

# SCIENCE AND ART.

## PROCEEDINGS OF SOCIETIES.

### INSTITUTION OF CIVIL ENGINEERS.

AT the meeting on Tuesday, the 10th of February, Mr. W. H. Barlow, F.R.S., President, in the chair, the Paper read was on "Iron and Steel at Low Temperatures," by Mr. John James Webster, Assoc. M. Inst. C.E.

The first part of the paper treated of the generally received opinions as to the condition of Iron and Steel at Low Temperatures, reference being made to the evidence given before the Royal Commission appointed to inquire into the application of Iron to Railway Structures, and to papers read before the British Association and elsewhere. An account followed of the results of experiments by the late Sir W. Fairbairn; after which, the elaborate series by M. Knut Styffe were mentioned, and the conclusions he arrived at were stated *in extenso*. From the results of these tests as to tensile strains, it appeared that the absolute strength of iron or steel was not influenced by severe cold, but that the ductility of these materials was increased. Mr. C. P. Sandberg had submitted rails of iron and of steel to a force of impact, and his deductions were quoted. The author then gave an account of the experiments he had made on bars of wrought iron, cast iron, malleable cast iron, Bessemer steel, and best cast tool steel, with a description of the apparatus used, and of the method of conducting the experiments. The bars were tested with tensile and transverse strains, and also by impact; one half of them at a temperature of 50° Fahrenheit, and the other half at 5° Fahrenheit. The lower temperature was obtained by placing the bars in a freezing mixture, care being taken to keep the bars covered with it during the whole time of the experiments. The results were given in eight tables, and the averages of all in a ninth table. Three sheets of diagrams accompanied the paper; the first sheet illustrated the testing apparatus; the second and third sheets showed the extensions of the bars at the different portions of their length, the appearance of the fracture, and the percentage of elongation and of reduction of area. The results of the experiments were summarised as follows, viz:—(1) When bars of wrought iron or steel were submitted to a tensile strain and broken, their strength was not affected by severe cold (5° Fahrenheit), but their ductility was increased about 1 per cent. in iron and 3 per cent. in steel. (2) When bars of cast iron were submitted to a transverse strain at a low temperature, their strength was diminished about 3 per cent. and their flexibility about 16 per cent. (3) When bars of wrought iron, malleable cast iron, steel and ordinary cast iron, were subjected to impact at a temperature of 5° Fahrenheit, the force required to break them, and the extent of their flexibility, were reduced as follows, viz.:—

| | Reduction of force of impact. | Reduction of flexibility. |
|---|---|---|
| Wrought iron .. | about 3 per cent. | about 18 per cent. |
| Steel (best cast tool) | ,, 3½ ,, | ,, 17 ,, |
| Malleable cast iron | ,, 4½ ,, | ,, 15 ,, |
| Cast iron .. .. | ,, 21 ,, | not taken. |

The paper closed with a review of the experiments described, with some remarks on the conclusions arrived at, and with a statement of the opinions formed by different authorities.

A case of samples of the fractured ends of the bars used in the experiments was exhibited.

MANCHESTER ENGINEERS, EMPLOYERS, FOREMEN AND DRAUGHTSMEN ASSOCIATION.—On Saturday evening Mr. Thomas Ashbury delivered an address to the members upon "The Tay Bridge Disaster," which was illustrated by excellent models made to scale, and by graphic diagrams. Mr. Ashbury alluded to the various popular modes of accounting for the accident, and afterwards gave his own views on the matter. Discussion ensued, in which the President, Mr. Asquith, Mr. E. T. Bellhouse, Mr. J. P. Woodhead, Mr. Rawlinson, Mr. Stansfield, Mr. Swallow, Mr. Walthew, and others took part, and great interest was shown in the engineering aspects of the unfortunate catastrophe. Mr. John Robinson (Sharp, Stewart and Co.) will preside at the annual dinner of the association, at the Queen's Hotel, on Saturday evening next, and the Mayor of Manchester has accepted the invitation to be present as a guest. This is one of the numerous scientific societies which are doing good work in Manchester.

THE MANCHESTER SCIENTIFIC AND MECHANICAL SOCIETY.—The eighth ordinary meeting of this Society was held on Friday evening last at 88, Mosley Street, in this city, when a paper was read by Mr. C. G. B. Corbett, Barton Arcade, Manchester, on "The Purification of the Rivers of South Lancashire." There was a moderate attendance, and the meeting was presided over by Mr. George E. Davis, one of Her Majesty's sub-inspectors of alkali works. The lecturer commenced by describing the present state of the rivers of South Lancashire, and then gave in detail the causes of their pollution, showing the different kinds of chemical manufactories, bleach-works, paper works, &c., and the pollutions arising from them and from sewage. In most cases, he said, the pollution might be remedied, and a profit result therefrom, and in those cases where no profit resulted there would be very little cost. In regard to the disposal of sewage he advocated the irrigation scheme, and pointed out where there was land suitable for irrigation purposes in the neighbourhood of South Lancashire towns. The lecturer next criticised the Rivers Pollution Act, and advocated more stringent measures, concluding with an exhortation to chemists and engineers to devote their energies to the solution of those problems. A discussion followed the reading of the paper, and the proceedings terminated with the usual votes of thanks.

LIVERPOOL ENGINEERING SOCIETY.—The usual fortnightly meeting of this Society was held on Wednesday, the 12th inst., at the Royal Institution, Colquitt Street, Mr. A. Ross, President, in the chair. Mr. E. H. Allies, Assoc. M. Inst. C.E., Engineer (Surveyor to the Local Board of West Derby), read a paper entitled "House Sewage," which was a continuation of one by the same author already read before the Society. The author divided his subject into two parts:—(1) "Household sewage in situations where a system of sewage more or less complete exists;" and (2) "In situations where no such system exists." In the first part, after showing the necessity of having a complete system of sewage for towns, it was argued that the water-carriage of sewage is the most efficacious method of removal, and that any system which admits of the retention of the refuse is open to grave objections. The directions of drains, their gradients, sizes, and the best material of which to make them, was next considered; and a table showing the various thicknesses and dimensions of sanitary pipes was given. The junction of house-drains with the sewer was treated at some length, and the use of junction-blocks advocated. The ventilation of house-drains and their proper trapping concluded the first part. In the second part, in situations where no sewer exists, the author showed the necessity of using the cesspool, and treated of the proper site to be selected, and the material and form of construction where a cesspool is unavoidable. He also showed in what very improper positions cesspools have often hitherto been placed, to the great danger of the health of the inmates of houses connected with them. Dry earth and other systems of sewage disposal were also glanced at, but were not recommended; and the conclusion come to was that the water-carried sewage system should always be adopted where practicable. The paper was illustrated by several drawings.

THE DISTRIBUTOR MACHINE.—Last week Messrs. R. Hornsby and Sons, of Grantham, by appointment, exhibited in the Guildhall Yard one of their Patent Distributor Machines to the members of the Streets Committee of the Commissioners of Sewers for the City. The inventors of this machine propose to obviate the serious disadvantages experienced in the streets of the City in rainy or frosty weather, when they become positively dangerous, by effecting an even and economical distribution of salt or sand on the roadway. The performance of the machine in the Guildhall Yard was watched with considerable interest and care by the Chairman and other members of the Committee, who expressed themselves satisfied with the result. The machine is very simple in construction, and occupies but little space. The feed is within the immediate control of the driver, and can be so regulated as to spread the sand, salt, or other material used, as thinly or as thickly as may be thought desirable, as fast as a horse can walk. We are informed that about 10 cwt. of sand is sufficient, with this machine, to cover with an ample distribution about half-a-mile of road for a width of several feet. Amongst those present were representatives of the Tramway and London General Omnibus Companies, to whom the machine will be of very material service. The "Patent Distributor" is also an agricultural implement for the distribution of artificial manure, in which character it was shown and highly commended at the Kilburn Meeting of the Royal Agricultural Society.

SOUTH AMERICAN INDUSTRIAL EXHIBITION.—We have received from the Consulate-General of the Argentine Republic the following extracts from the book of regulations of the exhibition to be held this year at Buenos Ayres:—"(1) The exhibition will be opened on the 15th of September and closed on the 15th of December, 1880. (2) Foreign exhibitors of industrial, agricultural, and all other machinery suitable for the requirements of this country will be admitted in accordance with the regulations of the exhibition. (3) Applications for space required must be made on or before the 1st May, 1880, addressed, 'Al Presidente de la Comision Esposicion Secretaria del Club Industrial, Buenos Aires.' (4) The charge to foreign exhibitors will be $F5 (£1 sterling) per square mètre. (5) Articles intended for exhibition will be admitted from the 15th of June to the 15th of August, 1880. (6) No article presented for exhibition can be removed until the close of the exhibition. (7) All articles exhibited must figure under the name of the parties soliciting their admission, and any prizes awarded will be given in the same name. (8) Exhibitors may inscribe the names of the manufacturers or agents on the goods exhibited as well as their own. (9) All goods intended for exhibition will be admitted by the Customs free of duty, but must come expressly for the exhibition; and as a guarantee that such is the case each lot of goods must come accompanied by a certificate from the Argentine Consul at the port of shipment. (10) All goods not reshipped after the close of the exhibition must pay the customary duties." Further particulars and the form of application for space may be had on application to the Argentine Consulate-General in London, 19, Craven Street, Strand, and to the Argentine Consuls in the principal cities of the Empire.

# MEETINGS FOR THE WEEK.

### MONDAY, FEBRUARY 23.

ROYAL SCHOOL OF MINES.—10 a.m. Professor Judd, on Geology. Noon. Professor Warington W. Smyth, on Mineralogy (opening of courses). 8 p.m. Professor Huxley, on Dogs and their Forefathers.

LONDON INSTITUTION.—5 p.m. Mr. G. Phillips Bevan, on Waves and Currents of Industrial Progress.

INSTITUTE OF ACTUARIES.—7 p.m.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.—8 p.m. Mr. H. Faija, on Portland cement.

SOCIETY OF ARTS.—8 p.m. Cantor Lecture. Mr. Thomas Bolas, on the Manufacture of Indiarubber. Special Applications in Surgery, Indiarubber Stereotypes, &c.

ROYAL GEOGRAPHICAL SOCIETY.—8.30 p.m. 1. Mr. Hore's recent visit to the Lukuga outlet of Lake Tanganyika. 2. Dr. E. Holub, the Marutse Mabunda Empire in S. C. Africa.

ROYAL ACADEMY.—8 p.m. Mr. H. H. Armstead, on Some Suggestions as to the Method of Study addressed to young Sculptors.

SOUTH KENSINGTON MUSEUM.—8 p.m. Captain W. de W. Abney, on Radiant Energy and its Relation to Photography.

### TUESDAY, FEBRUARY 24.

ROYAL INSTITUTION.—3 p.m. Professor Schäfer, on Physiology of Muscle.

GRESHAM HALL, LECTURE.—6 p.m. Professor Wylde, on Music, with vocal and instrumental illustrations.

ROYAL COLONIAL INSTITUTE.—8 p.m. Mr. A. Staveley Hill, M.P., on an Empire's Parliament.

SOCIETY OF ARTS.—8 p.m. Foreign and Colonial Section. Mr. W. Forster, of New South Wales. Views of Colonisation.

INSTITUTION OF CIVIL ENGINEERS.—8 p.m. Mr. W. H. Delano, on the Use of Asphalt and Bitumen in Engineering.

WEST LONDON SCIENTIFIC ASSOCIATION.—8 p.m.

SOUTH KENSINGTON MUSEUM.—8 p.m. Captain W. de W. Abney, on Radiant Energy and its Relation to Photography.

### WEDNESDAY, FEBRUARY 25.

GRESHAM HALL, LECTURE.—6 p.m. Professor Wilde, on Music, with vocal and instrumental illustrations.

SOUTH KENSINGTON MUSEUM.—8 p.m. Captain W. de W. Abney, on Radiant Energy and its Relation to Photography.

GEOLOGICAL SOCIETY.—8 p.m. 1. Professor T. McKenny Hughes, on the Geology of Anglesey. 2. Mr. F. S. Cobbold, on the Strata exposed in laying out the Oxford Farm at Sandford-on-Thames. 3. Mr. G. W. Shrubsole, on the Various Species of British Upper-Silurian Fenestellidæ.

ROYAL ACADEMY.—8 p.m. Mr. C. T. Newton, C.B., on the Recently Discovered Sculptures at Olympia.

SOCIETY OF TELEGRAPH ENGINEERS.—7 p.m. 1. Discussion on Mr. A. Eden's paper on Morse Signalling by Magneto-Electric Currents. 2. Discussion on Mr. Charles H. Wilson's paper on Compensating Induction in Parellel Wires. 3. Mr. Oliver Heaviside, on the Resistance of Galvanometers. 4. Mr. J. B. Stearns, on the Variation of Electro-Static Capacity in Submarine Cables. 5. Mr. H. R. Kempe, on Testing by Received Currents.

SOCIETY OF ARTS.—8 p.m. Mr. E. K. Muspratt, on the Noxious Gases Bill.

### THURSDAY, FEBRUARY 26.

GRESHAM HALL, LECTURE.—6 p.m. Professor Wylde, on Music, with vocal and instrumental illustrations.

SOUTH KENSINGTON MUSEUM.—8 p.m. Captain W. de W. Abney, on Radiant Energy and its Relation to Photography.

ROYAL INSTITUTION.—3 p.m. Professor Dewar, F.R.S., on Recent Chemical Progress.

LONDON INSTITUTION.—7 p.m. Mr. F. Wedmore, on Living English Painters.

INVENTOR'S INSTITUTE.—8.15 p.m.

ROYAL SOCIETY.—8.30 p.m.

SOCIETY OF ANTIQUARIES.—8.30 p.m.

SOCIETY FOR ENCOURAGEMENT OF THE FINE ARTS.—8 p.m. Mr. Walter J. Allen, on the Art Costume of the Stage.

NIPON (JAPAN) INSTITUTE.—At the Society of Arts. 4.30 p.m. Mr. C. Pfoundes, on Home Life of the Japanese.

### FRIDAY, FEBRUARY 27.

CITY OF LONDON COLLEGE.—6 p.m. Dr. Heinemann, on Political Economy, Money in Relation to Foreign Trade, Its Value as an Import, Foreign Exchanges, Equilibria of Imports and Exports.

ARCHITECTURAL ASSOCIATION.—7.30 p.m. Mr. T. J. Willson, on Structures between the Piers of Ground-Story Arcades in English Churches.

ROYAL INSTITUTION.—8 p.m. Weekly Meeting. 9 p.m. Mr. Frederick Bramwell, F.R.S., Sequel to the *Thunderer* Gun Explosion.

SOUTH KENSINGTON MUSEUM.—8 p.m. Captain W. de W. Abney, on Radiant Energy and its Relation to Photography.

GRESHAM HALL, LECTURE.—6 p.m. Professor Wylde, on Music, with vocal and instrumental illustrations.

ROYAL COLLEGE OF SURGEONS.—4 p.m. Professor Parker, on the Structure and Functions of the Vertebrate Skeleton.

QUEKETT MICROSCOPICAL CLUB.—8 p.m. Dr. T. Spencer Cobbold, F.R.S., on Human and Canine *Filariæ*. 2. Dr. Sylvester Marsh, jun., on Bleaching and Staining Microscopical Sections.

### SATURDAY, FEBRUARY 28.

ROYAL INSTITUTION.—3 p.m. Mr. George Saintsbury, on Dryden and his Period.

PHYSICAL SOCIETY.—3 p.m. 1. Mr. H. R. Ridout, on Some Effects of Vibratory Motion in Fluids. 2. Dr. C. R. A. Wright and Mr. E. H. Rennie, on the Determination of Chemical Affinity in Terms of Electromotive Force.

ROYAL BOTANIC SOCIETY.—3.45 p.m.

# METALLURGY AND MINING.

## THE HISTORY AND MANUFACTURE OF STEEL.

At the Edinburgh Philosophical Institution, last week' Prof. B. W. Kennedy, of University College, London' delivered two lectures on this subject. In the first lecture he spoke of the great change which had recently come about in the meaning we have attached to the word "steel." For centuries past, the lecturer said, steel had been a material for use chiefly for weapons, tools, and instruments where its extreme hardness and durability were its most valuable characteristics. But since 1830, when wrought iron first began to be used in large structures of any kind—ships, bridges, and so on—engineers had rather turned their attention to some of the other qualities possessed by steel, and had tried to find a material having the great strength of hard steel without its want of ductility. Such a material we now had in the so-called "mild steel" produced by the Bessemer and Siemens and Siemens-Martin processes—a material of enormous value in constructions, but in reality, often rather a pure iron than a steel proper. After a short description of some of the Eastern and other primitive methods of making steel, Professor Kennedy described in some detail the present method of making cast or crucible steel at Sheffield. He gave a short sketch of the life of Benjamin Huntsman, the Quaker inventor of the cast-steel process in the early part of the last century, and of the ruse by which his brother steel-makers succeeded in finding out his secret after their kindly attempts to prohibit the exportation of his steel, which they had at the same time declined to use themselves, had come to grief. He then sketched the various modifications of Huntsman's process now in use, described the leading characteristics of the materials produced by them, and concluded with a brief mention of some of the other steel-making processes, producing puddled steel, Uchatius' steel, &c.

In his second lecture, Professor Kennedy began by describing the method by which wrought iron is now produced, in order to show where lie the causes of defects in it, from which it was hoped manufacturers had, at last, to a large extent, freed themselves by the use of mild steel, or *ingot iron*. Then he proceeded to describe the Bessemer process, which had given rise to the modern steel-making industry in Europe and America. He mentioned that a paper read before the British Association at Cheltenham twenty years ago, of which the only record was the title, was the first publication to the world of a process which had revolutionised our most important metal industry. By the aid of diagrams he illustrated how the mass of cast iron is melted down in the blast-furnace, and then the liquid poured into a vessel called the converter. The characteristic part of the process is the blowing of air through the liquid iron to burn out all its impurities, the action of the air oxidising the silicon and carbon in the iron, and gradually reducing it to a state of purity—the temperature being raised by the process itself to such a pitch that the iron can be kept liquid, even when it has become wrought iron, and is at a temperature previously unheard of in any metallurgical processes whatever. Mushet's improvements were next commented on, and then the lecturer described the open-hearth, or Siemens process, the essential difference between it and the Bessemer process being that in the former case, the necessary temperature is obtained by the use of Siemens regenerators, and that the process is conducted much more slowly and gradually, so that the steel can be examined which is being made. The open-hearth method had its advantages, but practical engineers were divided in opinion as to whether the one was better than the other on the whole. He produced samples to show the extreme ductility and toughness of the mild steel or ingot iron, and then referred to recent attempts to render impure ores available for steel-making, as to the success of which he expressed himself sanguine. In that case, probably, the last obstacle to the spread of the Bessemer and Siemens process would be removed, and they would be able to make steel from ordinary ores, and so avoid the necessity of having to import immense quantities of fine ores. He made some general remarks upon the great influence of the introduction of the new material upon the iron industry; and as regards Scotland and the favour with which the modern method was at an early period regarded by the Clyde shipbuilders, said that, happily for them, the Clyde did not receive for many years what was its fair share, arithmetically speaking, of Government work. The Clyde men, left to themselves, formed their own ideas as to what was best in designs and material, unhampered by the notions of any Government department and dependent only on the excellence of the work they turned out, the seaworthiness of their vessels, and the strength and economy of their engines. The result had been that probably in no place had the new material come more rapidly or more successfully into use than on the Clyde. The new Forth Bridge, whatever form it finally took, would, he hoped, be one of the greatest, if not the greatest, examples of the use of mild steel in the world, and very probably be just an example of a structure whose very existence would scarcely have been possible but for this material. He had hoped to give some description of the material to be used in the proposed bridge, but upon communication with Sir Thomas Bouch he found this was not possible in the present circumstances. He added that he sincerely hoped that a statement which had several times been published might not prove true, and that the company or the contractor might not find it necessary to go abroad for a material, in the manufacture of which our own country stood pre-eminent; and especially, he hoped, it would not be necessary to go to a firm who, however excellent the work they turned out, had adopted the system of carrying on their work with a secrecy which contrasted very ill with the openness with which they themselves had always been treated by the manufacturers of our own country. He was sanguine that before long ingot iron might come to be used not only instead of wrought, but also instead of cast iron in very many circumstances.

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Professorship of Mining.—A professorship of mining is about to be established in the University of Durham College of Physical Science at Newcastle-on-Tyne. A suitable endowment will, it is understood, be provided in part by some of the more energetic members of the North of England Institute of Mining and Mechanical Engineers.

Find of Hematite Ore.—The discovery of a large bed of hematite iron ore at Sandscale, near Barrow-in-Furness, in a neighbourhood in which, up to a few months ago, the existence of metal was not known, is another evidence of the comparative inexhaustibillity of the hematite deposits of North Lancashire. The Sandscale Mining Company are proceeding with the work of sinking a new shaft, with the object of participating as soon as possible in the high values now obtained for this metal.

Improvement on the Davy Lamp.—It is important that the lamps in use in fiery coal mines should be of a kind that cannot be tampered with by the most ingenious or reckless workman, seeing that miners, notwithstanding the danger of the proceeding, having been found again and again to unlock their lamps by means of false or skeleton keys for the purpose of lighting their pipes; but Mr. James M. Douglas, Edinburgh, is said to have succeeded in constructing a lamp in which the moment an attempt is made to open it the light is extinguished. To open the lamp the bottom part requires to be unscrewed, and by an ingenious arrangement this operation also effects the withdrawal of the wick and the putting out of the light. The improvement can be adapted to the ordinary Davy lamp.

The Mineral Resources of China.—The immense coalfields of the Chinese Empire are slowly being developed, the superstitions of this strange people being overcome. In a district near Tchang, on the Upper Yang-Tsi-Kiang, a coalfield extending over seventy-five square miles has been tapped. At Wö-tze-kow ten beds of coal have been discovered; one of them, lying only 100 feet below the surface, is being worked, and at least 1,200,000 tons of anthracite have been exposed. *The Times* Shanghae correspondent complains that during the year which has passed next to nothing has been done to develop the resources of the country by Western mechanical appliances. The coal country in the province of Chih-li has been surveyed by foreign engineers, and mines are expected to be opened shortly. The iron districts in Hupei, on the southern bank of the Yangtse, have also been surveyed, but the surveyors' heads were broken and their escort routed by the Chinese villagers. Some machinery was ordered for the erection of a blast-furnace, but the enthusiasm of the official promoters has been damped by the hostility of the country people, and the machinery rusts in disuse.

The Waynaad Gold Fields.—The Indian Government has published an important memorandum on the Wynaad gold-fields. It begins by summarising the conclusions arrived at by Mr. Brough Smyth, practical mining engineer, employed by the Government to examine the quartz reefs. The reefs, according to his statement, are very numerous and of more than average thickness, are of great longitudinal extent, and highly auriferous. The country presents the greatest facilities for prosecuting mining operations at the smallest cost, and sooner or later gold mining will be established as an important industry in Southern India. The Government of India has proposed to the Secretary of State that the Madras Government should be authorised to grant gold-mining leases in lots of one to 30 acres, for a term of 10 or 20 years, at a rent of five rupees an acre, subject to the condition that not less than five labourers are regularly employed per acre on *bona fide* mining operations in such a manner as the Government may approve. Leases to be liable to forfeiture on failure of this condition. No royalty or other tax to be levied for the present, as the Government deems it most important to attract capital to the Wynaad gold-fields.

The Manufacture of Coke.—A patent of very great importance to coke manufacturers has just been taken out by Mr. A. M. Chambers of Thorncliffe Collieries, near Sheffield, and when it has been applied to the great number of coke ovens in Northumberland and Durham a great change will come over the production of coke both as regards quantity and quality. Mr. Chambers' invention is of a very simple character. Instead of allowing the draught to go over the burning coal by the furnace door. Mr. Chambers builds up the furnace door entirely and drives in hot air by means of a pipe over the face of the coal in a direct line to the exit flue; by this means the products of combustion pass from the oven to the main flue or chimney, a greater draught is thus obtained a quicker make of coke, and the sulphur is almost entirely got rid of. Mr. Chambers claims for his invention the following advantages:—At least 15 per cent. more coke from the same quantity of coke, a much larger quantity of coke per week in the same number of ovens; the objectionable sulphur is almost entirely got rid of; a much denser coke with less "breeze" and dust, and free from black ends; a considerable saving in the cost of coking, and that it is easily applied to existing ovens. The patent has been applied to 68 coke ovens at Westwood, near Sheffield, with the most perfect results.—*Newcastle Journal.*

The Mineral Riches of Japan.—The Japanese have now a completely organised Geological Survey, somewhat similar to our own, with a full staff of native surveyors, under an American chief, Mr. B. S. Lyman. The first Report of Progress of this survey, for 1878 and 1879, has just been published, and contains some accurate and valuable information on the mineral wealth of the country. Mr. Lyman describes a survey journey which he made with some of his staff from June, 1878, to February, 1879, extending over a distance of 2800 miles. Mr. Lyman reckons that the coalfields of Western Japan contain about 620 million tons; and, if one-third be deducted for the working, there will remain 400 million tons, representing a value at the coast of 1000 million dollars. Inconsiderable as this is in comparison with the large and rich coalfields of other lands, it is quite equal in value to all the metal products together, except iron. The copper of all the workable mines scarcely reaches the value of 750 million dollars; the eight or ten gold and silver mines, which were formerly worked, and may be so again, may—including the lead, antimony, and tin mines, the workability of which is doubtful—be valued at not more than 250 million dollars. On the other hand, the value of the iron amounts to at least 250,000 million dollars, or 250 times more than that of the coal. The relative importance of the mineral products of Japan (excluding Yesso and the small coalfields of Kii, Ise, and Iwaki) may be represented by the following numbers:—Iron, 1000; coal, 4; copper, 3; all other metals (chiefly gold and silver), 1. The total value of these products reaches the sum of about 252,000 million dollars—*i.e.*, just as much as the coalfields of Yesso, which in other respects is so poor in natural products. Mr. Lyman gives some details concerning twenty-four of the hot springs in Shimotsuke, Iwashiro, Uzen, and Ugo; and a table of the petroleum springs of Japan, according to which by far the most numerous and most productive are in Echigo and in Akita Ken; and the total delivery in the year 1879 was 4525 gallons per day.

New Steel Works at Motherwell.—The steel works in progress of construction by Mr. Colville, of Dalzell Ironworks, will cover 15 acres adjoining his ironworks. The process to be adopted is the Martin-Siemens principle, the same as used by the Steel Company of Scotland. There will be four 10-ton melting furnaces to begin with, equal to an output of about 500 tons of steel ingots per week. The melting shop will extend to 180 feet in length by 72 feet in breadth; thirty-two gas-producers will supply the gas required. The mill department will extend to 250 feet in length by 175 feet in breadth. A powerful steam-hammer, with an anvil-block of 125 tons weight and a striking-tap weighing 8 tons, will reduce the ingots to the required size for rolling. The rolling-mills will comprise one 28-inch plate mill for rolling plates up to 8 feet wide, and one 28-inch bar mill for rolling the largest sizes of angles, bulbs, and bulb tee beams. These mills will be driven by a powerful pair of coupled reversing high-pressure engines, of the most improved modern type, and are being made by the well-known firm of engineers in Glasgow, Messrs. Turnbull, Grant and Jack, Canal Basin Foundry. The ingot and slab-heating plant in the mills department will comprise five Siemens heating furnaces of large size. The boilers, entirely of steel, will be of compound flue and multitubular type, similar to the round class of marine boilers. They are four in number, and they will work at a pressure of 80 lb. The contract for the roofing of the works has been secured by Messrs. Laidlaw, Sons and Caine, Glasgow, and the roof will be entirely of iron, with galvanised corrugated sheets covering. All the foundations for the mill, engines, hammers, &c., will be of concrete. The cuttings and excavations for these founds are commenced, and Mr. Colville intends pushing the works rapidly on. With their close proximity to the intended North British Railway, their connection with the Caledonian, and with a plentiful supply of water from the Calder, few works will be situated in so advantageous a position for trade.—*Glasgow Herald.*

# SANITARY ENGINEERING, GAS AND WATER.

Birmingham Gas.—In their annual report, just issued, the Birmingham Gas Committee announce that they have made a net profit of £51,165 in the year's working. After payment of annuities and interest on loans, and making the necessary additions to the reserve fund, the profit will be divided in nearly equal proportions between the borough improvement rate and the sinking fund. The consumption of gas last year was the largest ever experienced, amounting to 2,645,000,000 cubic feet, or 150,000,000 more than in the previous year. In order to provide for this increasing consumption, the committee recommend an extension of the central works, at a cost of £75,000, which will add 6,750,000 cubic feet to the daily production.

Cumberland Waterworks.—£2000 is required in addition to the £28,000 originally estimated to cover the expenditure incurred in laying water-mains from Crummock Lake to Workington. The first sod of the Arlecdon and Frizington Waterworks was cut on Friday last in Cogra Valley. Here a reservoir covering forty acres of ground is to be constructed, with a capacity for holding 90,000,000 gallons of water. The watershed represents 1000 acres, and in this area there are innumerable springs. The embankment will be 30 feet high and 15 feet wide at the top, having a slope on the inside of 3 to 1, and on the outside of 2 to 1. The promoters calculate the supply will be three times as great as is required, but they have secured powers to supply villages and towns on the watercourse.

The Science of Gas Burning.—Major Sharratt gave an interesting lecture in the Old Town Hall, Manchester, last week on "The Science of Gas Burning, with Useful Suggestions." Mr. W. Horsfall presided. Major Sharratt called attention to the prevailing ignorance of the public generally as to the science of gas burning, and consequently the great injury to personal comfort and health as well as the heavy pecuniary loss resulting therefrom. Of all the gas that actually passes through the meters, and was paid for, from 30 to 50 per cent. was wasted from imperfect combustion and other causes, and so was injurious to the health and property of the purchasers. In Salford alone the direct loss so incurred was £30,000 per annum, in London it was £500,000, and in the entire country it was estimated at nearly £3,000,000 per annum. The chief cause of this waste of public money were (1) bad burners, (2) excessive pressure, (3) unsuitable arrangements of gas globes and fitting. To ensure the best results with the greatest economy it was essential to burn gas under low or very moderate pressure, and to effect this gas engineers and others had recently made great improvements in the construction of burners and regulators. The illuminating power of gas was better in Scotland than in England, owing to the superiority of the coal used in its manufacture. The price of gas varied considerably sometimes with the quality, frequently from other causes. In Leeds 18-candle gas was charged 2s. 2d. per 1000 cubic feet, in Edinburgh 28-candle gas was 4s. 2d., in London, 15-candle gas was 3s. 4d., in Salford, 20-candle gas was 3s. 4d. The lowest quality of gas made was equal to 14 candles, and the average price throughout the country was 4s. per 1000 feet. The lecturer noticed the great improvement in street lighting, as illustrated by the new Argand lamp at the bottom of Market Street, and the effective Bray lamps, with compound lights, used in Piccadilly. The use of gas regulators to be attached to meters, checking excessive pressure, and so preventing "blowing" and other waste of gas, was explained and illustrated by Messrs. Stott and Co.'s improved regulator, which, being constructed entirely of metal and glass, was found to be the most durable and constant in action, effecting, as the makers report, a saving of 30 to 50 per cent. in the consumption of gas used in mills, public buildings and houses. The relative merits of wet and dry meters, as well as the peculiarities of their construction, were also explained by Major Sharratt, and the great importance to gas consumers of taking weekly records of the index of the meter was strongly advised to prevent errors and extravagance.

## RAILWAYS & TRAMWAYS.

The Steel for the Forth Bridge.—The estimate of Herr Krupp, of Essen, for the steel girders to be employed in the construction of the Forth Bridge is said to have been 15 per cent. lower than that of the lowest estimate from any other firm. The saving in the use of the German manufactured steel in the construction of the bridge will therefore be £30,000.

The North-Eastern Railway.—The Castle Eden and Stockton branch of the North-Eastern Railway will be opened for passenger traffic on the 1st of March. In addition to serving the mineral district, the branch line will facilitate traffic between Sunderland and the south. It diverges from the Hartlepool and Sunderland railway near to Castle Eden, and joins the old line of the Leeds Northern near Stockton. Another of the great works of the North-Eastern Railway—the West Hartlepool Docks—will soon be brought into use.

New Line of Railway.—The officials of the Brighton Railway made an inspection of the new line between Eastbourne and Tunbridge Wells on Friday last. The works were sufficiently advanced for it to be decided to invite the Board of Trade to send down an inspector at once, so that the company might open the greater portion of the line for traffic next month. The wet summer and the severe winter have increased the engineering difficulties considerably, but they have all been overcome. Extensive works at Polegate Junction, to complete direct communication with Eastbourne will be pushed on rapidly during the summer, so that the entire route may be completed this year.

Conveyance of Iron Ore.—The Railway Commissioners delivered judgment on Saturday on the application of the Caledonian Railway Company against the North British Railway Company for a through route and apportionment of rates for the conveyance of iron ore from places in England on the lines of various railway companies, via Whifflet, to the following places on the North British lines, viz., Airdrie, Clarkston, Rawyards and Sheepford. Sir Frederick Peel said they were of opinion that the route proposed was a reasonable one, and as the rates were old agreed charges, and the public were interested in being able to send at these charges by the proposed route, they should allow the rates and routes applied for. There would be no order as to costs.

The St. Gothard Tunnel.—The engineers engaged in piercing the St. Gothard for the new railway hope to complete that work by the 5th of March. On that day there seems reason to expect that the last fragment of rock separating the north from the south tunnel will be removed. The result is considered not unsatisfactory. The work of piercing the Mont Cenis was begun in August, 1857, and completed on Christmas Day, 1870, that is, after 13½ years. The distance to be bored through the Mount St. Gothard is longer by 2696 metres, but the work promises to be completed after less than 7½ years, having been begun in September, 1872. The railway through the St. Gothard is to be built rapidly, so as to admit of being opened to traffic by the 1st of October of the present year.

Frightful Railway Accident in Scotland.—An accident of a serious nature took place on the Campsie and Uphall branch of the North British Railway, about a mile from Mid-Calder village, on Friday last. The line is a single one, and is used entirely for goods and mineral traffic. As a train, consisting of eight waggons and a van, laden with limestone, was nearing the viaduct spanning the river Almond, the axle of the fourth waggon broke, causing the hinder part to leave the line. The rearmost waggons rushed along at full speed, tearing up the rails for twenty or thirty yards. Dashing against the parapet, and knocking it down, two waggons and the van were precipitated into the river below from a height of something like 120 feet. Two of the guards and two other persons were killed. The bodies were frightfully mangled.

The Midland Railway.—The present week has witnessed some important changes in the staff of this railway. At the half-yearly meeting on Tuesday last, Mr. Allport retired from the position of general manager, which he has held for more than a quarter of a century, and is succeeded by Mr. Noble as general manager, and Mr. Richard Speight as assistant general manager. Mr. Allport has been elected a director, and was presented with £10,000 out of the last half-year's profits as an expression of the gratitude of the shareholders for services rendered by him to the company as its general manager during twenty-six and a half years. When Mr. Allport became its general manager the Midland Railway was about 500 miles in length; now it is nearly 1500. It ran from Derby to Bristol, Derby to Rugby, Derby to Bradford, and from Leicester to Peterborough. But it had no line to London, Scotland, Liverpool, or Manchester. It was shut in by powerful neighbours, who sometimes used it and always obstructed it, so that its shareholders were at one time much inclined to its absorption into the system of one of their number. A new policy was, however, introduced, and as a consequence the Midland now extends its operations in all directions through half the counties of England, enriching the shareholders by more than doubling the value of their shares, and serving the public by facilitating trade and manufactures, and making available large fields of coal and other mineral wealth which before were not in connection with large large markets. Of the policy which has achieved these results in the face of determined and persistent opposition, Mr. Allport has been the heart and soul, and he has the satisfaction of knowing that his career does not close before its objects have been attained and his expectations justified.

American Railway Construction in 1879.—The total of the year was 4430 miles, which is the largest since 1872, and has been exceeded only four times in the history of the country—the four years ending with 1872. For the eight years that we have made up this record, which includes road on which track was laid during the year, whether opened for traffic or not, and differs materially from the figures in "Poor's Manual" (which usually include only road open for business), the miles of new road constructed have been:—Year 1872, 7340 miles; 1873, 3883; 1874, 2025; 1875, 1561; 1876, 2460; 1877, 2301; 1878, 2916; and 1879, 4430 miles. Compared with 1878, therefore, last year shows an increase of more than 50 per cent. At the close of 1878, according to "Poor's Manual," the length of railway in the country was 81,841 miles. Adding the mileage constructed in 1879, we have the grand total of 86,263 miles of railroad in the United States at the beginning of the current year, when the total of all Europe is about 100,000 miles, and of all the rest of the world probably not 20,000 miles. The increase in this country was at the rate of about 5½ per cent., the increase of population being doubtless something less than 3 per cent., so that the number of inhabitants per mile of railroad has become less during the year. The population of the country is now probably about 49,500,000, and this gives 574 persons to support one mile of railway, against 585 at the beginning of 1879. In Europe the average is about 3333 per mile of road, and in Sweden, where the mileage in proportion to population is largest, it is 1667. We have given these figures before, but we repeat them to emphasise the fact that this is peculiarly the railroad country, not simply because it is big, but because the same population requires a larger amount of railroad here than anywhere else. Of the 4430 miles, 923½ miles are of narrow gauge (18 miles 2 feet, 23 miles 3½ feet, and the rest 3 feet gauge). This is a little less than 21 per cent. of the whole, against about 30 per cent. in 1878.—*Railroad Gazette.*

Omnibus Lines and Tramways in Paris.—The following details of the present state of the tram and omnibus service of Paris have recently appeared:—There are at present 72 lines, divided among four companies. The Compagnie des Omnibus works 32 lines of omnibuses, one secondary line of small suburban omnibuses, and 17 lines of tramways (of which the last, not yet terminated, are provisionally served with the aid of omnibuses), or 50 lines altogether. The Compagnie des Tramways-Nord works 10 lines of tram; that of the Tramways-Sud 11 lines; and that of the Chemins de Fer de Paris à Sèvres, Versailles et Extensions, one line, one of the oldest and longest of all (19 kilometres, run in 1 hour 50 minutes), that from Paris (Louvre) to Versailles (Place Hoche). There are altogether 39 lines of tramways. Of the 33 omnibus lines, 32 do not pass beyond the fortifications; only one does. Of the 39 lines of tramway, 14 (of which 11 belong to the Compagnie des Omnibus, three to that of the Tramways-Sud) are interior; the 25 others are prolonged, in a part of their course, beyond the fortified *enceinte.* The 39 lines of tramways do not comprise those of the Parisian outskirts which are entirely beyond Paris—viz., the line from Villiers-le-Bel-Gonesse (station) to Villiers-le-Bel, belonging to the Compagnie des Chemins de Fer sur Routes, and those from Rueil station to Marly-le-Roi, and of the town of Versailles, belonging to the Compagnie des Chemins de Fer de Paris à Sèvres, Versailles et Extensions. Putting aside the Versailles line, the longest line of tramways is that from the Louvre to Sèvres; its length is about 11,303 metres, and the length of the journey about one hour and ten minutes. The shortest is that from the Auteuil station to the *rond-point* of Boulogne, 2760 metres long, the journey being accomplished in twenty minutes. The longest omnibus line is that from the Panthéon to the Place de Courcelles, the length being 7657 metres; and the shortest that from the Porte de Charenton to the Place de la République, 3058 metres. The times taken on the journeys are not quite proportional to the distances. While the two preceding lines are travelled respectively in fifty-six and forty minutes, those from Clichy to the Odéon, from Montmartre to the Place Saint Jacques, from the Madeleine to the Bastille, and from Belleville to the Louvre, are travelled—the first two in fifty-eight minutes (the length of the one being 6756 and that of the other 6678 metres); the other two in thirty-two minutes (the lengths being 4588 and 3852 metres.

## ELECTRICITY, TELEGRAPHY

The Telephone in Leeds.—Telephonic communication is now being formed, at the instance of the Corporation, between the Leeds Town Hall and the waterworks reservoir at Eccup; also between the Central Gasworks in Meadow Lane and the branch works at New Wortley, and in several other establishments. The telephone is being largely introduced on the system of the Lancashire and Yorkshire Railway—about 400 instruments having been supplied to that company; whilst its advantages are also being developed by business firms.

The Electric Light.—Experiments are in progress at the North Shore Mills, Liverpool, under the direction of Mr. Ward, engineer of the British Electric Light Company, with the André incandescent lamp, which is said to possess several special advantages. The light is contained in a globe hermetically sealed, and, as the carbon rods are thus protected from contact with the air, they are not subject to combustion, or the combustion is so slow as to be almost imperceptible. The lamp is simple and effective. It is self-adjusting, devoid of mechanical appliances, and, as the carbon points are not consumed, it will remain illuminated for an indefinite length of time. The avoidance of any renewal of the carbon points is an obvious advantage, as is the fact that the new system admits of a complete subdivision of the current of electricity.

Progress of Long Range Telephoning.—An important experiment with the telephone was made on January 25th, between the Union Pacific Transfer on the east side of the Missouri River and the American Union office at St. Louis, a distance of 410 miles. The experiment previously made between Omaha and St. Louis had been unsatisfactory. Superintendent Dickey, of the telegraph lines, and also head of the Bell telephone system in the West, Manager Korty, of the Union Pacific Telegraph Office, and Manager France, of the Omaha Telephone Exchange, conducted the experiment at this end of the wire, and Mr. Benedict, of the American Union, and Mr. Duraut, of the St. Louis Telephone Exchange, conducted the experiment for St. Louis. Two jars, Callaud battery, were used at the Omaha end and five jars in St. Louis. But two or three interruptions of a few seconds each occurred, and these were clearly due to the "swinging" of the wires in the strong wind which was blowing. An ordinary conversation was carried on with the utmost ease, the most noticeable fact being that, while the enunciation of the words was perfectly clear, they came invariably with the regular vibration of a musical note. The wires over the greater part of the distance were quiet and not in use, but at the St. Louis end there was a heavy induction.—*Scientific American.*

## NAVAL ARCHITECTURE.

### CHAMBER OF SHIPPING.

The third meeting of the Chamber of Shipping was held on Friday last at the Cannon Street Hotel, Mr. John Williamson, of Liverpool, in the chair. There was a full attendance of members, representing all the principal shipping associations of the country. The Chairman, in his address, argued that the statistics of trade and shipping for the past year bore out the view he had advanced twelve months ago, namely, that the building of ships had been carried on more extensively than the requirements of the trade demanded, and, after a careful and minute analysis of returns for the last decade, he showed that while cargoes (taking tons of imports and exports) from 1869 to 1879 increased 43 per cent., the tonnage of shipping increased 116 per cent., or, taking the years 1872 to 1879, cargoes increased 15 per cent. and tonnage 48 per cent. With regard to the shipping disasters of last year, he deprecated legislation such as that proposed to prohibit the carrying of grain in bulk, and said that the tendency of the day being to cheapen food for the masses, grain would be handled and conveyed in bulk. He maintained that vessels could be constructed so as to carry grain in bulk or heavy dead-weight cargoes without capsizing or foundering, unless under very exceptional circumstances. Further, he asked whether recent legislation had not had something to do with such disasters? It seemed to him that the principles of construction which had been adopted in many cases in order to comply with the Acts regulating the loading of ships with grain in bulk had possibly introduced new sources of danger. The placing of the disc on the ships' sides, although an owner's load-line, had a tendency to make the builder give the greatest apparent amount of free-board, and thus diminish the stability of the ship when carrying dead-weight cargo. This danger, moreover, was intensified by the system of placing empty water-ballast cells at the bottom of the ship.

Mr. John Glover, who was unanimously elected president for the ensuing year, in beginning his address referred to the question of overbuilding which had been dealt with by his predecessor, and pointed out that the cheap rate at which it had been possible to build last year, compared with present prices, afforded some justification of the investment thus made by shipowners. Dealing with the responsibilities of shipowners, he said they must improve the quality of their seamen. The next point related to a scientific question. Although our engines now distanced all competitors, perfection had by no means been yet attained. It was said that the work got from the best engines did not exceed 7½ per cent. of the force latent in the coal they consumed, while those of less efficiency gave only about three per cent. Another matter to be considered that day was the tendency to increase charges against navigation. The charge on shipping of £39,335 in one year (1878), as payment for Custom-house officers' "overtime," was a striking illustration of the way in which a public Department might sanction arrangements which resulted in great extravagance and harm, under the pretence of protecting the Revenue. With reference to the charges levied on ships passing through the Suez Canal, he mentioned that the charges for lights and pilotage together amounted, on about 1200 net register, to 11 per cent.; that, in other words, besides paying the toll (£650), the owner had to pay £73 for lighting and pilotage. On the subject of recent and heavy losses of shipowners, he expressed an opinion that, putting all wheat and maize cargoes into bags, so far from lessening losses in the American trade, would aggravate the evil. The Montreal authorities compelled all 'tween-decks grain to be carried in bags, and, besides, three tiers of bags on the top of planks above the loose grain in the lower hold. If our Government could induce the Government of the United States to enforce regulations something like the Canadian throughout its ports, all that it was desirable to do on this point would be done. In confirmation of this view, he stated that during the years 1875-9, the North of England Iron Shipbuilding Association—the largest company of this kind in England—insured from 650 to 860 steamers per annum, and out of this large number of vessels only six Atlantic grain steamers were lost. He did not see his way to any useful enactment on the subject. The mutual associations and the owners had the matter in their own hands; they would cure what was curable if left alone, and it would be easier for them than for Parliament to find the way to do this. The consideration of resolutions on subjects proposed by various shipowners' associations followed. The four resolutions with regard to grain cargoes and shifting boards excited some discussion, in the course of which a method of loading in bulk, suggested by Captain Boult, was mentioned and described by him as having been found to prevent shifting of the cargo. By this plan, it was explained, the lower holds are filled with grain shipped in bulk; between decks are bags of grain, but large, properly fitted "trunks" are left round the dimensions of the hatches, and filled with loose grain, which falls and fills up any vacant spaces left by the settlement of the cargo.—The Chairman said there was every reason to believe that Government would appoint a Commission to consider the subject. In view of this it was resolved "the Executive